Concrete

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Good Stucco and Bad

IT is too much to hope that there will not always be with us a certain percentage of builders who will "skin" the job whenever they can.

There is another class of builders, a little better citizens than the first—but not much better— who will do "a cheap job" because that is all the owner is paying for.

A good builder is still higher up the scale. He is more civilized; has better standards. He carries onto a job with him a certain dignity of his calling. There is something in his code that won't let him do a job unless he knows it is a good job—at least until the owner has been told all the hazards and why the job won't be good. Even then a top-notch builder won't do the cheap job because he won't have his name linked up with bad work.

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What we had in mind at the start was stucco. Stucco is much in demand. The public, for the most, doesn't know good stucco from bad—*until afterward.* It is already *afterward* on thousands and thousands of jobs. Bad stucco is proving itself here, there and all over. Still the public doesn't know. It doesn't know how to judge stucco.

The builders who are putting it on either *do* know or *should.* The "Stucco Recommended Practice" of the American Concrete Institute tells precisely how. These standards are tried and proven. They have been carefully revised and kept up to date. They describe the best way to do the job to make it a lasting job. Probably not one builder in ten uses the American Concrete Institute standards.

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A good many portland cement stucco people have seen magnesite stuccoes under many different patent names come on the market. They have predicted failures for this material—that it won't stand the weather. We don't know that yet. Time will tell. A good deal of very bad work has been done with magnesite stuccoes. But the magnesite stucco business has been making progress because it has had energetic salesmanship and behind that salesmanship it has, more recently, had a good deal of study and research. The point of the matter is that the people interested in portland cement stucco need to do a little housecleaning on their own account. A good deal of the interest in that material has been casual because portland cement stucco has not until recent times been a ready prepared product. *Stucco has not been sold.* The *ingredients* have been sold but portland cement stucco has not had the same kind of direct sponsorship that some of the magnesite stuccoes have.

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The portland cement stucco situation can not be in very good standing when a man interested in magnesite stucco production and use (the man in charge of technical work for the producers of a much advertised magnesite product), when a man in such a position will write to CONCRETE (not for publication but by way of friendly comment) as follows:

> There is more cement stucco per unit of population on the Pacific Coast than there is in any other section of the country. Although climatic conditions here are remarkably mild, yet we cannot help feeling very strongly that the majority of the cement stucco now placed in this district will show serious failure inside of the next few years. Practically all of the construction is so new that failure has not yet reached a point where it is noticeable, but careful examination shows extensive cracking, loosening of stucco layers, and similar indications of early complete failure. The cause is traceable in practically all of the instances to faulty construction and application practice. (Observe that our magnesite friend does not attack the *material,* but the way it is used.) The recommendations of the American Concrete Institute for portland cement stucco are never, or almost never, followed. Stucco is frequently applied to chicken wire stretched over black paper tacked directly on 2 x 3 studding. You can imagine about what condition this type of stucco work will be in after two or three years.
>
> Although we manufacture and market a competitive material, we are seriously concerned over the situation here, for stucco as a type of building material will unquestionably fall into some measure of disrepute when the extensive failures which must be expected begin to appear. We would be very glad to see the regular section of your journal devote some attention to the situation here on the Coast and point out the fallacy of much of the current practice here.

It is perhaps time that promotional effort on portland cement stucco be turned even more energetically toward getting the work into the hands of local producers who will do more extensively what is already being done in some large centers, in getting portland cement stucco on the market in ready mixed brands and following up the jobs to see them done right—something which can only be accomplished by making stucco knowledge more general among builders. The architects could help a great deal to eliminate bad stucco. Stucco is good only when it *is* good.

Business Cycles

BUSINESS cycles do sometimes run according to prediction. In November, 1921, in the Cement Mill Section of this magazine, Robert W. Lesley called attention to a cycle of conditions which he has seen repeated several times in his long association with the cement industry, indicating a more or less regular recurrence of certain activities, in the construction industry.

The first period in the cycle was described as characterized by busy times among manufacturers and dealers with new construction of mills, factories, store buildings and so on. The second period shows increased railroad traffic, new construction, bridges, tracks, stations. The third period is marked by increased wealth and consequent investment in hotels, office buildings, country houses, small dwellings. The fourth period shows a special activity in public works by national, state, county and town governments in the construction of roads, bridges and waterworks and other matters of general public utility.

At the time this matter was published, Mr. Lesley directed attention to the fact that in November 1921 there was behind the dam, so to speak, in the construction industry, an uncompleted work yet to be done, all the work that the railroads would normally have done in their quarter of the cycle, which had been passed over by a break in that cycle, due to unusual conditions. The backed up work, with all the public work, was likely to cause an unprecedented demand for cement and other building materials in 1922 and 1923. Mr. Lesley now calls attention to the announcement of present indications of the continuation of the building boom throughout the country this spring, with the railroads preparing to make large expenditures. Press dispatches carry information as to budgets of 27 railways representing 40% of the mileage in the United States, by which the *Railway Age* estimates that the total railway expenditure this year will be around $700,000,000. Among the larger individual budgets are: New York Central, $29,000,000; Pennsylvania, $55,000,000; Louisville & Nashville, $27,000,000; Norfolk & Western, $32,000,000; Northern Pacific, $20,000,000; Baltimore & Ohio, $18,000,000; Rock Island, $15,000,000; Western Pacific, $7,500,000.

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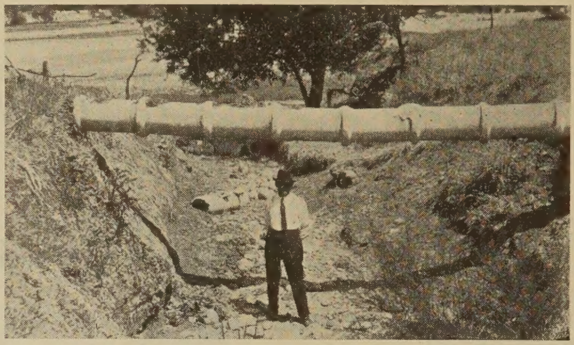
Burial Vault Advertising and Sales Practice

The recent publication of a steel burial vault advertisement in a magazine going to funeral directors was brought to the attention of CONCRETE because this steel vault advertising referred to concrete burial vaults in very disparaging terms.

The matter was brought to the attention of the publisher of the funeral director paper on the ground of unethical advertising and of questionable facts. In the reply received from this publisher, there is a hint for concrete burial vault manufacturers—something that may bear looking into. It is in the following paragraph from his letter:

> It happens that the concrete vault business is localized. In many instances, the cemetery authorities use the sale of concrete vaults as a form of petty graft, and I believe that this merchandising practice is more largely responsible for the antipathy for concrete vaults than structural weakness of the better grade of concrete vaults.

Unusual Performance of Concrete Pipe



What is a 20-ft. clear, unsupported span of 14-in. unreinforced concrete pipe full of water and without a leak? You might answer, "An Impossibility", unless you had seen the accompanying photograph. Or you might answer, "An example of good concrete, good headwork and good workmanship." The picture is of a line recently laid by our San Diego branch manager, Harry B. Tellyer, on the ranch of Antonio Izuel, near Tia Juana, Mexico. The pipe was laid across a fill which had been placed in a small ravine to bring the line up to grade. Soon after completion, a flood caused by a cloud-burst washed the fill entirely out from under the pipe line, leaving it suspended in the air. After being thus suspended for eight months and without any support, water was turned into the line, with the result that this 20-ft. stretch of unsupported pipe held up its own weight of 1500 pounds and 1400 pounds of water, total 2900 pounds without a sag, crack or leak. In the background are some pieces of old, inferior, handmade concrete pipe which failed and was replaced by our machine-made pipe. It is our standard 14-in. sewer pipe, 30-in. lengths, 1⅜-in. shell, 1:2:1 mix and made on a Hammond tamping machine. Mortar was 1:2 mix. I consider this a remarkable demonstration of two elements: first, the possibilities of strength in machine-tamped concrete pipe; second, the strength of the bond between cement mortar and concrete pipe when carefully and intelligently placed.—ERNEST F. BENT, Manager, California Glazed Cement Pipe Co., Los Angeles, California.

We can't get, by *experience,* all the knowledge we need. We have to depend on the experiences of others. Why not swap ideas?—Editor.

Developments in Surface-Treated Concrete[1]

How to Make Plaster and Glue Molds

By R. F. Havlik
Vocational Director, Loyal Order of Moose, Mooseheart, Ill.

I feel I can discuss the developments in surface treatment of concrete without bias, because at Mooseheart we have made use of practically all the known processes. Our primary business is to educate dependent children and teach them a useful trade in order to make them self-supporting when they graduate from our high school. The manufacture and sale of concrete products is but incidental to this great work.

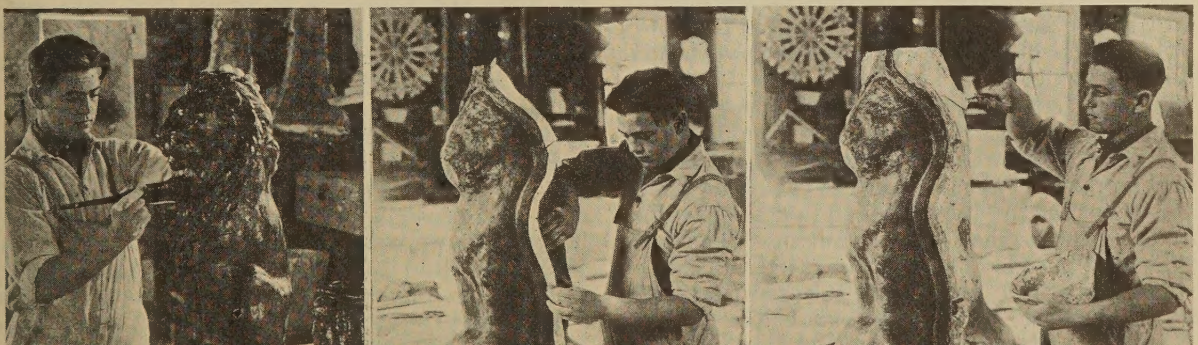
Among the many trades that we teach at Mooseheart is that of the manufacture of ornamental concrete. By this term we mean decorative concrete for building purposes and decorative purposes in parks, gardens, etc. We naturally include some instruction in the manufacture of plain concrete trim stone and concrete blocks, but we do not spend much time on these because we feel that any man who is competent to manufacture high grade decorative building stone is also competent to manufacture the plain trim stone, concrete building blocks and other similar products. That part of the work can be taught a student in a few weeks at most, but it takes several years to turn out a first class mechanic qualified to make models, molds and the finished concrete products.

The principal products that we "sell" are our graduates, if you will pardon this expression, and the only selfish motive that I have in discussing this subject is the hope that concrete products plants will add trim stone departments to their business, and thus provide additional positions for competent men who are thoroughly trained in this work.

As stated above, at Mooseheart we use practically every known process of surface treatment, using whichever is best suited to the particular job at hand. Because of the fact our boys are likely to work in plants using any of the better known methods we must train them in all. Each method of surface treatment has its own peculiar advantages and oftentimes several methods can be used to excellent advantage on the same job—at least, that has been our experience.

You who have investigated the subject have doubtless found that many a manufacturer is very reticent to discuss just how he treats his molds, what ingredients he uses and other things which make for success or failure. I well recall that I visited several ornamental stone plants before I learned how glue molds were treated to prevent undue disintegration. We have no secrets and always welcome visitors to our plant, and will always cheerfully furnish any information pertaining in any way to the manufacture of high grade ornamental concrete.

The selection of concrete blocks and trim stone for all the permanent buildings at Mooseheart was significant and a tribute to the enduring and pleasing qualities of this product. Mooseheart is thronged throughout the warm months of the year with visitors, principally members of the order, from all over this country and even in the colder weather hardly a day passes but we have several visitors. Practically every visitor to Mooseheart becomes an enthusiastic believer in surface-treated trim stone and building blocks. We attribute this high regard for our building material to the fact that nearly all of our buildings are constructed of surface-treated concrete blocks and trim stone. All the blocks used in our buildings are surface-treated and are faced with crushed granite. The trim stone used in the buildings up to 1916 was made with a smooth surface of white cement, white sand and white marble. This checked more or less, but since 1916 the trim stone also has been made of surface-treated concrete faced with crushed granite



Figs. 1-3—The First Three Steps in Making a Glue Mold (See Text)

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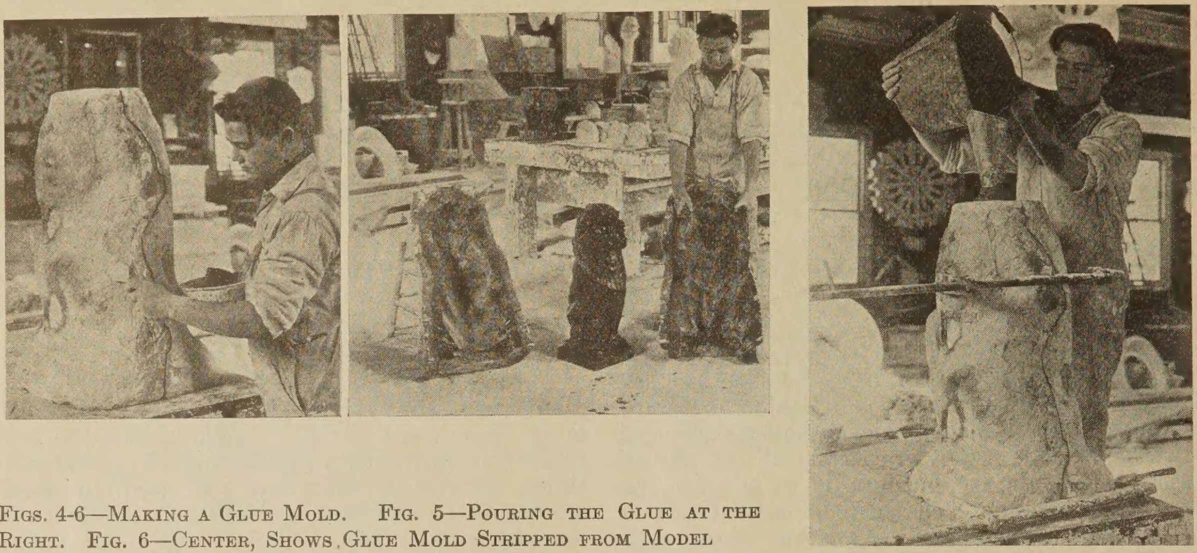
[1] Courtesy American Concrete Institute (*Proceedings*, Vol. 19, 1923)—being portion of paper presented at recent convention.



FIGS. 4-6—MAKING A GLUE MOLD. FIG. 5—POURING THE GLUE AT THE RIGHT. FIG. 6—CENTER, SHOWS GLUE MOLD STRIPPED FROM MODEL

and white portland cement. From 1913 to 1916 gray cement was used in the blocks and white portland cement in the trim stone, but since 1917 both blocks and trimstone were faced with white portland cement. The granite used is known to the trade as Crown Point spar. Numerous visitors from the East where granite is used much more commonly than in the central states, have remarked that our product is just as attractive as the natural material. One group of men, when examining one of our buildings, thought it was natural granite and wondered how we could use it so far from the source of supply, and was greatly surprised to learn it was surface-treated concrete instead.

What has been done at Mooseheart can be done in any of the larger cities in this country. I find that architects, as a rule, are highly in favor of good concrete, but do not use it to any great extent because they cannot find manufacturers competent to furnish it. But for surface-treatment of concrete, concrete blocks would be doomed for use in foundations under inexpensive buildings and for backing up in high grade buildings. Surface-treatment has done more to promote the greater use of concrete in various forms than any other one factor. Therefore, too much stress cannot be laid on the importance of producing attractive surfaces in both mass concrete and concrete products. In order to find a ready sale for concrete products, they must meet three requirements:

1. Be sufficiently strong for the purpose intended,
2. Must have an attractive appearance,
3. Must stand outside weather conditions without checking or crazing.

In the larger cities the building ordinances protect the consumer on the strength requirements. The customer can determine for himself the attractiveness of the product, but he cannot so easily determine whether or not the product will stand outside weather conditions without checking or crazing. The only products known today that will not hair check are those that have been faced with selected aggregate, containing no dust or fine material below about a No. 20 mesh, and have been surface-treated. The manufacturer who can guarantee his product to meet all three of these requirements can do a volume of business that will only be limited by the capacity of his plant. Modern machinery and the comparatively low cost of cement and concrete aggregates as compared to other materials make it easy to compete with other building materials.

During the next few years we will undoubtedly enjoy the biggest building boom that this country has had, so manufacturers will do well to market a product at this time which will meet these conditions, and in later years, when times may not be as good, it will be the best sort of a guarantee as to the quality of their product.

It has been a very common practice to imitate Bedford stone, and in doing so manufacturers have been tempted to use white silica sand and other similar fine material. The result has been that when made into trim stone the product has invariably checked to a greater or lesser extent—usually to a very great extent. Stone of this character hurts the industry beyond measure.

A surface which has been treated to expose the aggregate will not check, provided no fine material has been used in the facing. By "fine material" I mean dust and all material that will pass a No. 20 screen. If the owner or architect insists on a surface that would be smoother than that produced by material of this character the wise manufacturer will let his competitor take the job rather than run the risk of the surface of the material checking and thus hurting his reputation. Although it is true that stone has been made with finer material than the above without checking, it is the exception and not the rule, and only goes to prove that finer material had better not be used in the facing. The best results will be obtained by using especially selected coarse sand and fine pebbles, crushed granite and other similar aggregates, from which all dust and fine material has been removed.

For our regular building blocks and trim stone we use one part of white portland cement to one part each of Nos. 3, 3½ and 4 Crown Point spar. For lamp posts we use one part cement to one part each Nos. 3, 3½ and 4 Crown Point spar and one-half part of crushed pink granite. These mixtures produce stone which positively will not check when exposed to outdoor weather conditions, regardless of the process used in producing the stone, it being understood of course that in all cases we expose the surfaces of the aggregate by some special treatment, which I will describe later.

For garden furniture we use similar mixtures, sometimes substituting a little crushed white marble for some of the Crown Point spar, and occasionally using the next smaller size Crown Point spar if the ornaments have very fine detail. We refrain, however, as much as possible, from the use of the finer aggregates.

We have always treated the surface of our blocks but for the first few years we made our trim stone with a smooth finish similar to that of Bedford stone. Most of this stone checked considerably. In 1916 we started treating the surface of both the trim stone and blocks, with the result that since then we have eliminated hair checking entirely in all of our trim stone. The blocks never hair check. It is a peculiar fact that blocks produced by any process will seldom check on the surface, regardless of the type of surface produced and facing material that is used. Yet the same facing material, if used in trim stone, will cause considerable checking. There are many theories for this—the most common of which is that in manufacturing trim stone, especially when made by the tamped process, the workman is likely to smooth the stone with a trowel, and thus bring an excess of cement to the surface, which ultimately causes hair checking; but frequently the same material that will not cause hair checking in blocks will produce hair checks in cast stone, which would seem to contradict the idea that the checking is caused by troweling the surface of the stone. The safest procedure is to avoid the use of the fine aggregates entirely, and to treat the surface of all products. The surface produced is the most pleasing obtainable, and will build up a permanent future for such products.

The Market For Surface-Treated Products.

Ordinary concrete products for building purposes can compete only with common clay brick, and then frequently only in appearance and not in cost, for in some localities clay brick are sold for less money than good blocks can be produced for. Such blocks look better than common brick, but can hardly be said to look as well as even the cheapest of face clay brick. For this reason the profit on such products is not great. The surface-treated products are so superior to ordinary concrete products that there is no comparison between the two. The logical market for such products is in competition with the very best grade of brick, terra cotta and cut stone. For that reason the profit against such competition is big, and the manufacturer can afford to make a high grade product that will be above criticism at all times. The field for these products is unlimited, because masonry buildings are daily becoming more common and usually high grade pressed brick, terra cotta and cut stone are used for the facing of such buildings. The most profit to the manufacturer and the greatest saving to the user come in the use of surface-treated concrete blocks, as a substitute for cut stone, terra cotta and pressed brick. Such jobs, as a rule, cannot be converted into concrete block jobs, in their entirety, but will require the use of both concrete blocks and trim stone. For this reason it is but logical that all concrete products plants operate trim stone departments. Without such departments they must confine most of their sales to foundation jobs, and that means competition with the cheapest of competing materials.

Methods of Surface treatment

There are several methods of surface treating concrete products. In one method the product is usually made of cast concrete. When it has hardened sufficiently the exposed surface of the stone is ground with carborundum wheels. Special machines are made for that sole purpose. This treatment produces a very pleasing surface, and if the concrete is composed of the proper aggregates, the surface will not hair check or craze. This method is employed by three or four of the most reliable manufacturers in the eastern states. When this method is employed the product is frequently cast in sand molds, but not always.

Another method for surface treating concrete is to spray the surface of the green product with a very fine spray of water under pressure just as soon as the product is removed from the mold. The effect of this is to wash off the surface cement and drive it into the concrete, thus exposing the natural surface of the aggregate. The product is then cured until it is hard enough to use. Sometimes the surface of the product is further treated by scrubbing it with muriatic acid and water. This will brighten the surface and remove all traces of cement from the surface of the aggregate. Some prefer this to the sprayed surface because the surface is brighter. When crushed granite or marble is used in the surface the stone glitters more than if the surface has merely been sprayed and not scrubbed. In another method—particularly when the product is cast by the wet process, the stone is allowed to cure thoroughly, and then is dipped in a strong solution of muriatic acid and water. High grade garden furniture is practically always manufactured by this method. It is also found to be very economical in the manufacture and treatment of high grade trim stone —particularly when the product is highly ornamented.

The best way to build an acid tank is to make it of concrete and then line it with sheet lead. The joints in the lead have to be burned by a lead burner. Solder will not withstand the action of the acid. The lead lining should, in turn, be protected with a lattice work of thin wooden strips fastened together by wooden pegs. No other metal of any kind should be used in the lining of the tank as the acid will eat it up.

Plain trim stone is usually made by the tamped process, and even though it is made very wet, such stone can be treated very economically by first spraying with water and then scrubbing it slightly with muriatic acid and water after it has been cured.

One kind of concrete block, when made with a granite or similar surface, is allowed to cure for 24 hours and the surface of the block is then scrubbed with water. This is one of the simplest and earliest forms of surface treatment, and also one of the most economical. This method, however, works well only with blocks that are set face down on a pallet. In practice it is found that blocks in which the face is exposed to the atmosphere while curing cannot be scrubbed in this manner with satisfactory results, apparently because the surface of the block is too hard when the back of it is sufficiently hard to permit handling, and if scrubbed earlier, the surface is too soft and crumbles at the edges. The setting of a block face down on a pallet appears to retard the hardening of the facing without having the same effect on the rest of the block, and the result is that the surface can be scrubbed satisfactorily the day after the block is made, without spoiling the edges of the block.

These various methods have been used to a greater or lesser extent since the early part of the century —as far back as 1903. In my opinion, it helps considerably to spray the face of the block while it is still in the machine, or just after it is removed from the machine. In such cases the block should be scrubbed the following day. We find this treatment reduces the cost of scrubbing, and also produces a surface that sparkles more than one that is scrubbed only and not sprayed.

Facing Materials

Very beautiful effects are obtained by screening out the right size pebbles from especially selected sands, but unless one is fortunate enough to have his plant located in the immediate vicinity of sands that are suitable, the manufacturer is limited to the use of crushed granite and marble, because these are the only materials suitable for facing purposes that are being marketed on a big scale. There is no one, to my knowledge, marketing especially selected sand for facing purposes. Several eastern firms obtain a granite effect by mixing crushed marble with crushed slag in the proper proportions. One well known manufacturer uses especially selected pebbles. In the central states the material that is most easily obtained for this purpose is the crushed granite shipped in from the East, and from Wisconsin and Minnesota. Stone that is faced with crushed granite and sprayed or scrubbed, produces a surface that is very nearly the same as that of bush hammered granite. When the surface is cut with carborundum wheels a sort of terrazzo effect is produced. Those who use carborundum wheels use coarser aggregates than those who spray the surface or scrub it with acid or water. Whenever the same kind of aggregates are used, any one of these methods will produce a surface very similar to that produced by any of the other methods, excepting in the case of tamped stone. Tamped stone, when faced with white cement and granite, can be made wet enough to produce a surface that is practically the same as cast stone, but as a rule, manufacturers make it drier than is necessary, and the result is that the tamped stone is darker in appearance than cast stone. When both have to be used in the same building(frequently the case at Mooseheart) the tamped stone must be made just as wet as possible, in order that there may be no noticeable difference in appearance between that and the cast stone.

In our work at Mooseheart, where we produce our own blocks and trim stone, and also do our own construction work, we frequently cast arches over windows and door openings right in place at the building, facing the surface with granite and white cement to match the other stone. This requires considerable skill in order to make the two kinds of stone match perfectly. Usually we remove the surface forms within a few hours after the forms are filled, and spray the surface of the stone. The next day we scrub it and about the third day we cut false joints in these arches to match up with the other blocks and trim stone. The false joints are filled with the same kind of mortar as is used in the rest of the building. These are matched so well that many experienced men who examined these buildings have been unable to see any difference in appearance between these arches cast in place and the adjoining blocks and trim stone. We use this method as a matter of economy, finding that the stone cast in place in this manner when there are several arches that are of the same size, can be produced at less cost than when the individual pieces were pre-cast in the plant and set in place by the masons. From a manufacturers' standpoint, however, this would not be practicable, as ordinary building mechanics are not competent enough to cast such arches in place to match stone that may be produced elsewhere. The largest arch we cast in this manner was 19 ft. inside diameter.

The manufacture of trim stone for high grade buildings always involves more or less the manufacture of high grade decorative stone. This is produced in glue or plaster molds—depending upon the nature of the ornaments. A plant producing such stone will require the services of modelers, model makers and mold makers. Modelers receive the highest wages paid to men engaged in the concrete products business. Those who devote their entire time to this receive as much as $2.50 per hour. Some plants are fortunate enough to have modelers who also do plaster work when necessary, and occasionally such men can be had for $1.50 to $2.00 per hour, provided they are given all-year-around employment. Model makers receive from 90c to $1.25 per hour in union shops, and mold makers about 10c per hour less. In non-union plants the scale for model makers is about 85c, and mold makers about 10c an hour less. We aim to produce mechanics who are good mold and model makers and can do ordinary modeling so they can work in any of these branches as needed.

Modeling

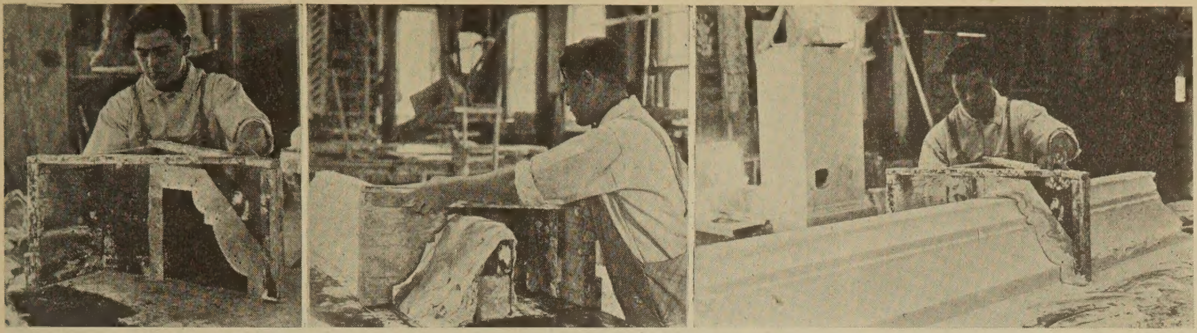
A modeler will usually reproduce the desired ornament in clay or modeling wax. Occasionally he will carve it out of a block of plaster or use a combination of plaster and clay. When the model is completed by the modeler it is turned over to the mold maker, who produces a mold in which the original model can be reproduced in concrete.

Glue Molds

If the piece is to be reproduced in a glue mold it must be shellacked thoroughly with orange shellac. The purpose of this is to keep the moisture in the clay from ruining the surface of the glue. If the model is to be reproduced in a plaster piece mold this treatment is not necessary. The next step in making a glue mold is to place a thin layer of clay over the entire model. The thickness of the clay should not exceed three-quarters of an inch; this is later replaced with glue. The next step is to coat this with a thin layer of pure molding plaster of paris of the best grade obtainable. This must be worked rapidly so that the plaster does not harden before this section of the mold is completed. The next step is to build up the section with fibre dipped in plaster of paris. The fibre is used to reinforce the plaster. Should the mold crack the fibre will hold the pieces together. It is the cheapest material obtainable for this purpose. Burlap can also be used, but is not as satisfactory. The fibre used can be purchased from leather tanneries and consists of the scrapings of hides, the surface of cocoanut shells and rope hemp. The plaster is mixed by partly filling a dish with water and then scattering a handful of plaster at a time over the entire surface of the water so it will absorb the water quickly and not form lumps. This should be continued until the plaster shows up at the surface of the water. It should then be stirred with the hand or a large spoon until it is of a creamy consistency.

Fig. 1 shows how shellac is applied to a clay model of a lion. Fig. 2. shows the building up of the clay partition. In this particular case straps of sheet metal were used for this purpose. Fig. 3 shows the construction of one section of the plaster jacket. When this section of the plaster jacket sets up, the plaster partition surrounding it is removed. The edges of the section are then trimmed off smooth, and joggle holes are cut into each edge. The edges are then shellacked and greased and the next section is built in the same manner. Fig. 4 illustrates the construction of the second section (which in this case is also the the last section), of the mold for the lion.

The next step is to remove the plaster jacket from the model. When this is done the clay surrounding the model will usually adhere to the sections of the



FIGS. 7-9—RUNNING A PLASTER MOLDING (SEE TEXT)

jacket. The surface of these plaster jackets is then scraped and trimmed as smooth as needed. They are then thoroughly shellacked and all the sections of the jacket and the model are greased. The grease commonly used is made of kerosene and stearine wax mixed in the proportion of four parts of kerosene to one part of wax. The jacket is then reassembled around the model and clamped with clamps of fibre and plaster ties across the joints. A funnel is then set over the top of the mold and held in place with a fibre and plaster tie. The mold is then poured full of hot glue. The glue used is known as "casting glue" or "gelatine", and can be purchased of large packing companies, tanneries and wholesale paint houses. The glue comes in flake form, and is prepared for use as follows:

The amount of glue required for the mold is placed in a tub or pail and covered with water. After about five minutes all the water is strained off as well as possible, through a gunny sack or screening. The glue is then placed in a steam or hot water jacketed kettle until it melts. It is ready for use and as poured to make the mold, is allowed to cool and harden. The following day the clamps or plaster ties are removed and the jacket pried loose by driving an ordinary wood chisel into the joints of the mold. The glue jacket is then cut through to the model on the lines corresponding to the joints in the plaster jacket. The pieces of glue are then removed from the model and the model can be destroyed or set aside for further use.

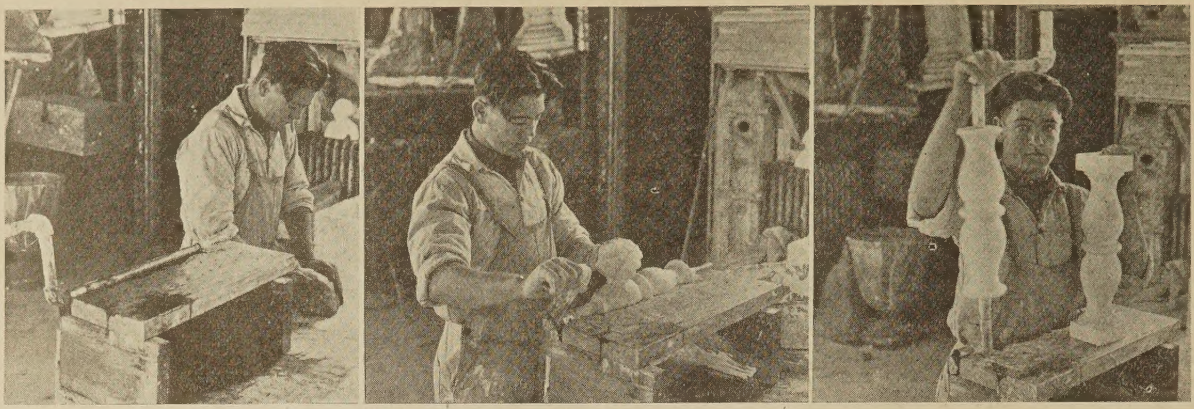
Fig. 5 shows this glue and plaster jacket for the seated lion. The next step is to powder the surface of the glue with pulverized soap stone commonly known as French chalk. This is rubbed into the surface with a dusting brush. The purpose of this is to remove all grease from the surface of the glue. The glue is then thoroughly painted with a saturated solution of powdered alum and water. This is done to harden the surface of the glue. The glue is allowed to dry for two hours or so, and is then painted with a paint of the consistency of cream, made up of litharge, linseed oil, turpentine and Japan drier, mixed in equal parts of each ingredient. This paint is then allowed to dry on the glue twelve hours, or over night, and will thoroughly waterproof the surface of the glue. Without this treatment only one or two good casts could be produced with a glue mold, whereas molds so treated can oftentimes be made to produce as many as ten or twelve casts. Some manufacturers use white lead paint, and heavy varnishes for the same purpose, but in our opinion, the litharge paint gives the best results. After all this treatment the mold is ready for the production of concrete casts.

The concrete should be mixed to a slushy consistency so it will run freely enough to get into all the details of the mold. It is best to make it as dry as possible, but the driest mix used usually is what would be termed at least "sloppy". In warm weather the mold can be removed from the product the following day, but in cold weather it is best to leave it in the mold for two days or longer. The product should then be steam cured for at least two more days, after which it can be surface-treated. When the cast leaves the mold it usually has some defects, in which case it should be pointed up with the same mixtures as were used in the original cast. This can be done either before or after it has been steam cured. If done after it is steam cured, product should be put back in the steam room for at least another 24 hours. The best way for surface-treating the product is to then dip it in a solution of muriatic acid and water, as already described. The product has to remain in the acid solution from three minutes to an hour—depending on the age of the product, the effect that is desired, and the material that is used.

PLASTER MOLDS

Any piece produced in a glue mold can also be produced in a plaster piece mold; some manufacturers prefer the plaster piece molds to glue molds. This preference ofttimes is not based on good judgment, however, as I will bring out later. In producing a plaster piece mold the problem is somewhat similar to the manufacture of a glue mold. The first step is to build a small section at a time that will draw freely from the model. This section should be made as large as possible, but if the model is highly ornamented it will usually be very small—sometimes just a few inches in each direction. A mold for a small ionic cap for a 12-in. column may consist of 30 to 35 pieces in all. A clay partition is built up in the same manner as for a glue mold, and a section made of plaster reinforced with fibre. When one section is completed the surrounding clay partition is removed and a similar partition built around the adjoining section. This section is produced in the same manner until the entire model is surrounded with small pieces of plaster, all of which will draw freely from the model.

The pieces of the mold are usually marked to indicate the order in which they should be removed from the cast and reassembled again in the mold. These pieces, when completed, are surrounded by a casing of plaster (the mother mold) to hold them in their correct positions. The edges of each piece of the mold as it is made are shellacked, as described, and when the entire mold is completed all inside surfaces of the mold are shellacked and greased as described before. The mold is then filled with concrete in the same manner that glue molds are poured.



FIGS. 11-13—TURNING UP A MODEL FOR BALUSTER

HOW CHOICE SHOULD BE MADE BETWEEN GLUE AND PLASTER PIECE MOLDS

When only a few pieces are to be made from a given mold it is usually more economical to make a glue mold for the purpose, rather than a plaster piece mold. If a large number of pieces are to be made from the same mold it may be more economical to use the plaster mold instead. Many manufacturers, however, in my opinion, err in using plaster piece molds for almost all their work. We have found from actual experience that if a given piece is highly ornamented, a glue mold can usually be produced for half the cost of a plaster piece mold. The further advantage of a glue mold over a plaster piece mold is that there are less joints in the mold, and consequently fewer seams in the finished cast that have to be removed and pointed. This means that the actual manufacturing cost of the concrete cast is less in a glue mold than in a plaster mold.

In producing stone that must be true in all dimensions to the plans, great care must be taken that the lines of the mold are correct and that the glue does not become too soft, or the mold will bulge and the cast be out of shape.

MODEL MAKING

If the piece that is to be reproduced is symmetrical the model is usually made of plaster by a model maker. In large plants certain men make models only, others make molds, and still others do modeling.

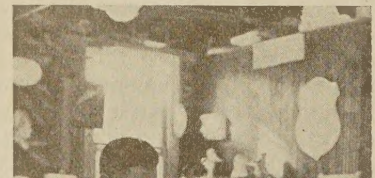


FIG. 10—TURNING UP A PLASTER BALL.

The first step in producing a model is to make a sheet metal template corresponding in shape to the reverse of the section to be produced. If the piece to be produced is a straight molding this template is mounted on a board (see Fig. 6). It is necessary to have a flat top table, preferably covered with a piece of slate that has a true, straight edge perfectly square with the top of the table. The template mounted on a board is run along the edge of this table. Plaster and fibre are set on the table in front of the template, and the template is run in one direction over this, and scrapes the plaster to the shape of the template. The molding gradually takes form, and the process is continued by adding more plaster to the form, as needed. After the molding is completed it is cut in pieces like lumber, with a saw, and mitred and fitted to the desired size. The sections are then stuck together with plaster of paris, and the joints pointed up neatly with plaster until the model is finished true to the design. It is then shellacked and greased in the same manner as a clay model.

The mold for reproducing this is usually made of plaster, but glue molds can be used if desired.

If the section to be produced is cylindrical in shape the template is mounted on a stand slightly more than half the diameter above the top of the table. An axis consisting of an iron pipe is then set the proper distance from this template at the same level as the template. The center of this pipe forms the axis of the finished model. A handle is attached to one end of the pipe by means of two elbows and two short pieces of pipe. The next step is to put a thin layer of clay on the pipe so that the model, when finished, can be removed readily from the pipe. Plaster of paris, mixed to the consistency of thick cream, is then poured on this axis. As it starts to set up, the pipe is revolved slowly. The template cuts off the surplus material and gradually forms the plaster to the shape of the template. More plaster is added to the rough model as needed, and this process is continued until the model is completed. When the model is completed it is removed from the axis, and assembled with other parts to make the finished object. Fig. 7 shows the mounted template for a straight molding. Fig. 8 shows the first operation. Fig. 9 shows the molding almost completed. Fig. 10 shows how a model for a ball is made.

Fig. 11 shows a template and pipe all ready to spin a baluster. Fig. 12 shows the baluster being formed, and Fig. 13 shows the finished baluster still on the pipe and also shows another baluster complete with the top and bottom square pieces.

How to Make Forms for Concrete Buildings —*Stairs*

By William F. Lockhardt
Lockhardt-Byrne Co., Inc., New York City

> Articles on forms for Footings, Columns, Walls, Beams and Girders, Flat Slabs and Belt Courses and Cornices, were published in previous issues, February to August, 1922. The present article on Forms for Stairs completes Mr. Lockhardt's series. Mr. Lockhardt's descriptions of form work are based on the actual practice of some of the most successful concrete building contractors in the United States. There has been such a demand for these articles, due to the previous scarcity of literature on the subject, that the issues of Concrete containing them could not meet the demand. The entire series is now being reprinted by the Concrete-Cement Age Publishing Co., 1807 East Grand Boulevard, Detroit, in a handy little volume, at $1.00—Editor.

Stair construction in concrete is not necessarily as complicated as a first view of stair form work in place would seem to indicate it to be. The problem when analyzed simply resolves itself into two or three operations, each easy enough in itself. Principally, it is required to build one or more landings at locations and elevations shown on the drawings and the placing of a run of steps between these landings and the floors either above or below as the case may be.

Each run, in brief, has to have so many treads of a certain length to span a fixed horizontal opening, and so many risers of a certain height to span a fixed vertical dimension. A sloping form is needed for the soffit of the stair run and some kind of provision must be made to shape the ends and front of the steps. The whole system, when completed and ready for the concrete, must be adequately supported the same as any other piece of form construction.

That, in short, is a statement of the problem and its solution. The methods employed are just as simple as the problem itself proves to be when separated into its component parts.

The landings will be the first part of the construction to be dealt with, as it is obviously necessary to build them first. They are usually of simple beam-and-girder construction, sometimes supported by light concrete posts from the floor below and sometimes by recesses cut into the walls of the stair shaft into which the landing beams can be framed. In either case there is nothing complicated about this part of the work and the construction of both columns and beam and girder forms has been fully dealt with in preceding articles.

In Fig. 1 is shown the simplest kind of stair—a short run between two floors. Landings have been omitted in the interest of simplicity and clearness. Where landings are involved the operations are practically the same, except that the forms for the stair run instead of butting against a beam already concreted will frame into the beam form at the edge of the landing.

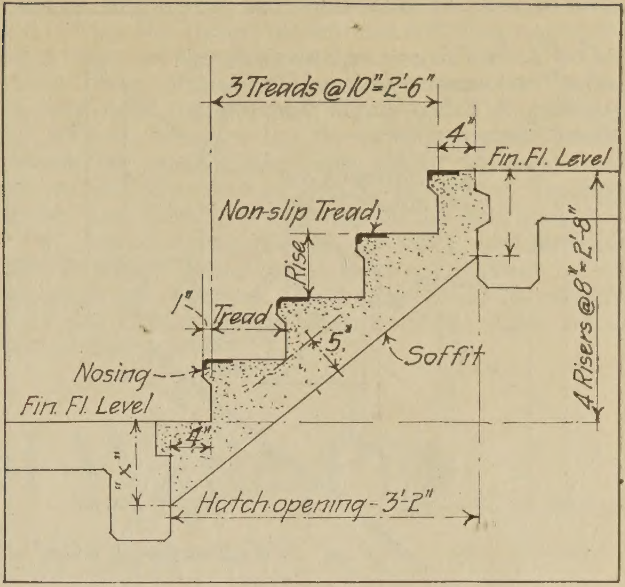


Fig. 1—Typical Stair Run

The first thing that will be noted is that the stair opening or hatchway is 8 in. longer than the stair run itself, figuring from face to face of the first and last risers. The exact figure for this excess will vary with different contractors, but 3½ in. or 4 in. is common. This play room at each end makes it possible to keep the end risers vertically over one another in the different runs regardless of minor variations in the size of the hatchway, which it is usually difficult to hold exactly plumb. The form work is simpler and a much more workmanlike job of framing is obtained in the completed stairs when viewed from below after the forms have been removed. When this method is used it is not necessary to set the anti-slip tread for the top step (the floor) when the floor is filled, as the 3½-in. or 4-in. extension provides the room necessary to set the ordinary non-slip tread.

Where figures are given in this article they will refer only to the stair shown in Fig. 1 which will be taken for an example throughout. Figures will be used because by so doing the explanations will be made shorter and more easily understandable. The proper figures for rise and tread must be substituted on other jobs for those given here and there will of course be a corresponding variation in the other dimensions.

Referring now to Fig. 1 we find that we have three treads at 10 in. each, with which to bridge the horizontal opening or hatchway. The tread is figured exclusive of the nosing, being the horizontal distance between the faces of two adjoining risers. To this 30 in. must be added the 4 in. at each end for clearance.

The depth of the stair slab is always given on the working drawings. This is the dimension (at right angles to the soffit of the stair) between the soffit and what is marked as the "slope line" in Fig. 2. For example, it is given as 5 in.

After the landing forms have been built, or if there are no landings as in this case, before any of the other form work can go ahead the panel for the soffit of the stair must be placed. The panel is usually made up of ⅞-in. boards with the boards running parallel to the stair run, mounted on 3-in. x 4-in. or 4-in. x 4-in. spreaders or cleats, spaced about 3 ft. apart. These are in turn upheld by two or more longitudinal stringers under which are the usual posts. Before the panel can be made up and placed, it is necessary to know its length and it must be determined at what

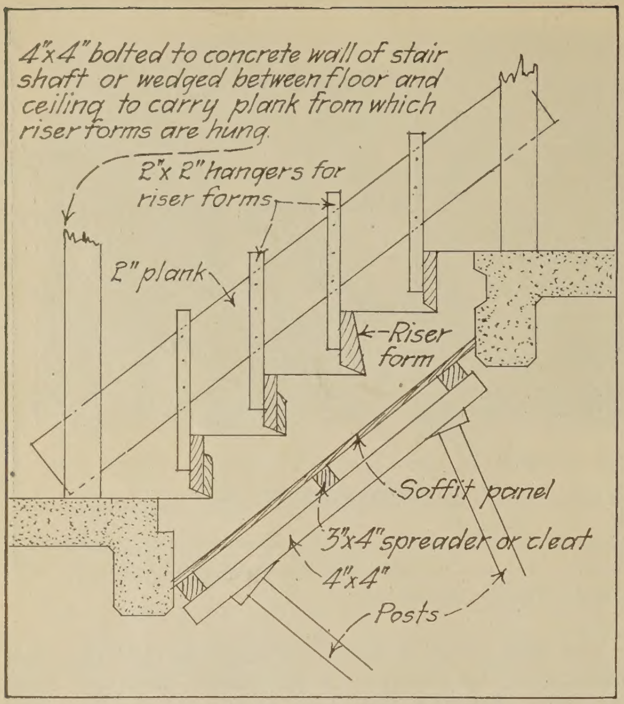

4"x4" bolted to concrete wall of stair shaft or wedged between floor and ceiling to carry plank from which riser forms are hung.
2"x 2" hangers for riser forms
2" plank
Riser form
Soffit panel
3"x4" spreader or cleat
4"x4"
Posts

FIG. 2—RISER PROFILES HANGER FOR HOLDING RISERS IN LINE AND RESTING

elevation it must be placed with reference to the beams against which it rests at each end. As a matter of convenience, a small detail of this part of the work can be laid out on large scale at any convenient point and the necessary dimensions scaled off, close enough for all practical purposes.

Such a sketch is given in Fig. 3. Riser and tread are laid out and connected by a diagonal line such as is marked "line of slope" for convenience in identifying it. This line is of course parallel to the soffit of the stair, which in this case is 5 in. from it (the thickness of the slab). The line for the soffit is next drawn as shown, and the lower end prolonged far enough to intersect a line drawn from a point 4 in. in front of the face of the riser, to indicate the location of the face of the beam.

The vertical dimension "X" is now measured off from the sketch. This is the figure we have been seeking—the distance below the finished floor slab at which the soffit strikes the face of the beam. The operation is repeated at the other end and the distance between the two points measured, after which the panel is cut and placed.

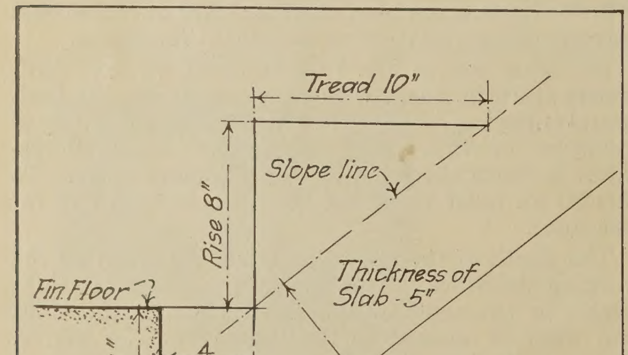


FIG. 3—LAYING OUT STAIR

For the sides or stringers, 2-in. plank dressed two sides to 1¾ in. are used. The length of the stair run between girders on the line of the soffit is marked on the plank and each end cut off at the proper angle to make it fit between the beams. This angle is most easily obtained by laying out at the bottom of the plank and starting at one end, one riser and tread, using the lower edge of the plank as the diagonal. Reference to Fig. 4 will help make this clear, the tentative riser and tread being laid out at the left end of the plank and indicated by dotted lines.

After the end of the plank has been cut off at the proper angle the dimension "X", previously obtained, is marked on the cut edge as shown. The 4-in. clearance space is marked off parallel to the tread. Alternately then afterward riser and tread are marked off until the end of the run is reached. By measuring in from the lower edge of the plank 5 in. for the thickness of the slab, the "slope line" may be established, and the correctness of the work checked, as the interior angle between riser and tread should be on this line in every case.

It will be found advisable to lay the work out quite lightly at first, as the error resulting from the wide lines drawn with a carpenter's pencil will mount up and the last tread will be shy quite a little. It will then be necessary to go back and lay out the lines with greater accuracy. In this case, light lines which can be worked over easily will be found an advantage.

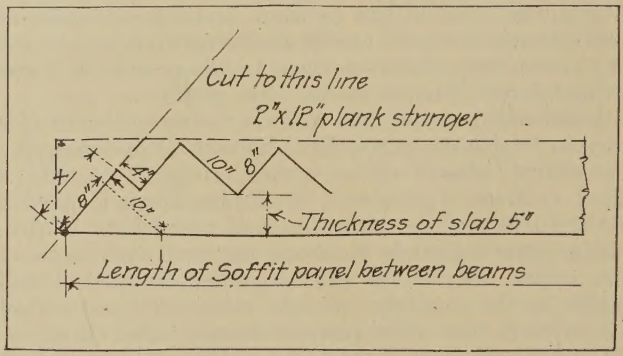


FIG. 4—METHOD OF CUTTING STRINGERS FOR CONCRETE STAIRS

Different types of risers are shown in profile in Fig. 2. In most cases the riser is vertical with an overhanging nosing, but in some cases the riser itself is battered or sloped outward. In any case the object is the same—to get a wider tread than would otherwise be possible and to improve the appearance of the finished stairs. In laying out such a stair it must be borne in mind that the form work riser will not be the same as the concreted stair riser, unless there is no molding. The form work riser will naturally be at the edge of the nosing, and the undercut will have to be obtained by means of a panel nailed to the face of the form work riser, as shown in the drawing. This is important in cutting the stringers to receive the risers.

It is customary to bevel the lower edge of the riser form to an edge as shown in Fig. 2, so that in finishing the stairs the mason may reach in with trowel right to the riser.

Where the stair adjoins a concrete wall and no outside stringer is possible some other means must be found to support the outside ends of the riser forms.

A method probably as simple as any is shown in Fig. 2. A 4-in. x 4-in. post is wedged up in position on each floor as near to the stair as may be possible and a heavy plank nailed between the two posts at an angle approximately parallel to the stair run. Or if the wall is concrete and some of the bolt holes are still available a 4-in. x 4-in. may be bolted to the wall at each end of the stair run. The plank is then nailed to the 4 x 4's. 2-in. x 2-in. hanger pieces are nailed to the outside of each riser and to the plank to hold up the outside end of the riser forms. If necessary, diagonal spurs from the plank may be used in addition to keep the hanger pieces from swinging out under the pressure of the concrete.

Top forms for the treads are not necessary as the concrete used for stairs is of very stiff consistency and will not overflow the riser forms to any extent. Because the posts under stairs are at an angle from the vertical, they are subjected to heavy bending stresses and should be well stay-lathed and braced.

Two sets of stair forms are generally used in order that the concrete may get at least a week's set before the forms are removed. Reshores should be immediately put in and kept in place until the stairs are at least 28 days old.

Concreting Steel Water Pipe in California

By R. W. Whitaker
Portland Cement Association

Domestic water for the cities of National City and Chula Vista and the surrounding territory, as well as irrigation water in the adjacent agricultural district, is supplied by the Sweetwater Water Corp. The source of supply is a reservoir on the Sweetwater river while the distributing system is by pipe line.

Most of the pipe lines are slip joint riveted steel and have suffered the natural deterioration of such material. In 1918 several of the lines were in such condition that the repair gangs could not keep up with the leaks and some action was necessary. Two plans were proposed—one to relay the lines, using cast iron pipe of bell and spigot type, the other to case the old pipes in concrete.

Three conditions led to the final selection of the latter method of handling the problem. One was the fact that cast iron pipe was and is quite expensive in this section and concreting the old lines gave promise of a financial saving. Another factor was that in laying cast iron pipe approximately 75% of the cost would be spent in the East for materials, the 25% spent locally being for labor. In concreting the old lines, approximately 75% of the money would be spent locally—the 25% representing the cost of cement, not leaving Southern California. The most vital point, however, was that if properly laid, the concreting of the old pipe should produce a line of more lasting qualities than new cast iron and no service interruption would be necessary.

Such a program was entered upon with the result that they now have so treated 132 ft. of 2-in., 443 ft. of 3-in., 974 ft. of 4-in., 14,736 ft. of 6-in., 3,140 ft. of 8-in., 8,962 ft. of 12-in., 1280 ft. of 18-in. and 3,785 ft. of 24-in.—a total of 33,452 ft.

The work has been attended with uniform success. At first there were union troubles in solving some of the details of construction but the estimated financial saving was apparent from the start.

The importance of quality concrete was recognized and care was taken to obtain it. Materials used were pea gravel for coarse aggregate and sand for fine aggregate, both obtained from the Otay washing plant of Fenton-Parker Material Co. The proportion used was 1:2:3. As dry concrete was used as could be gotten into place with careful spading where walls were thin and reinforcing was in place.

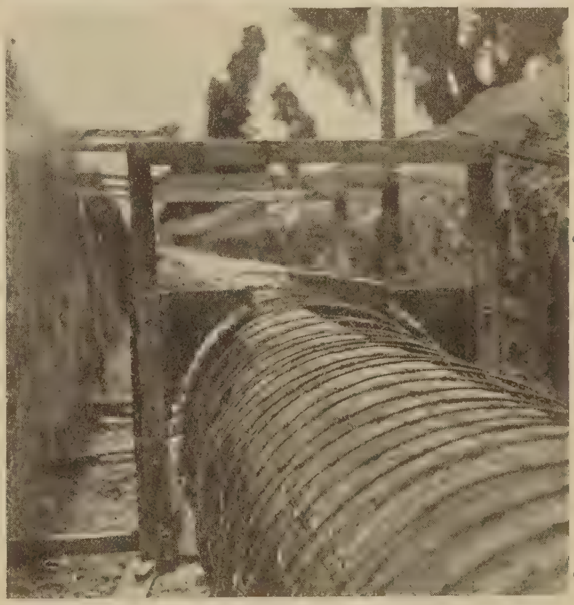


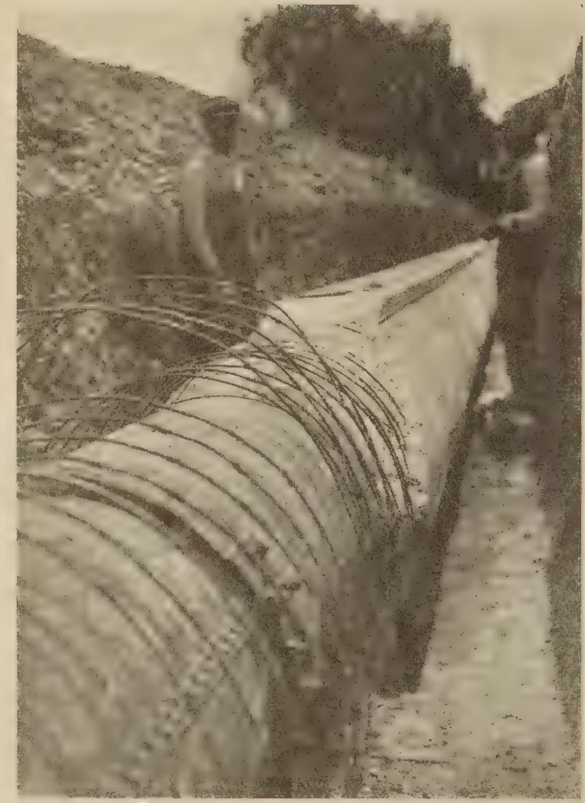
Fig. 1—The Equipment and the Gang

Fig. 2—Steel Reinforcement in Place in Foreground; Forms Shown in Background—In Actual Practice Bottom Forms and Concrete are Placed First

A system of forms was developed that were easily stripped and work was made continuous. As can be seen from photographs, the forms were made in four pieces, two top and two bottom. For the 18-and 24-in. pipe, forms were in 8-ft. lengths. For smaller sizes the lengths were 12 ft.

The first operation was to uncover the old line, make necessary repairs to leaks and set on blocks which would raise the pipe from the ground twice the thickness of concrete shell for that size of pipe.

Next, wire mesh reinforcement in 14-in. widths and of wire size to give area of steel given later was spirally wound around the pipe.



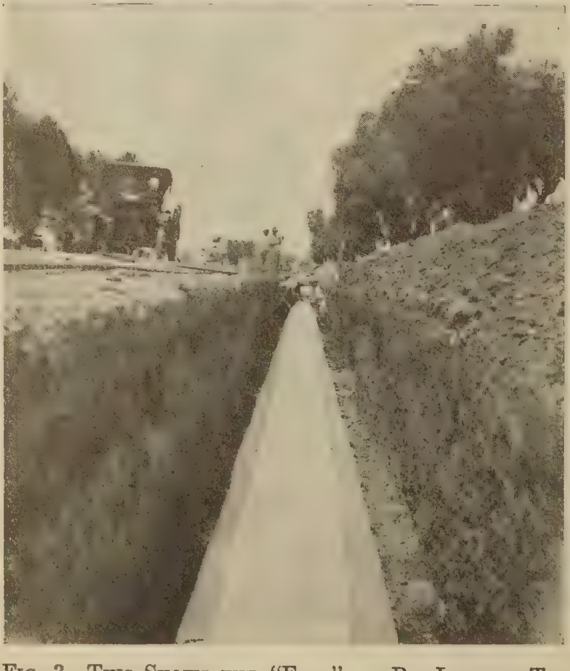


Fig. 3—This Shows the "Flat" or Rib Left on Top and Bottom

Fig. 4—24-In. Pipe Under Construction

Bottom half of forms was then placed and concrete placed to mid-section, immediately following which top half of forms was placed and remainder of concrete placed. The placing of concrete in lower half preceded placing in upper half by but one form length.

From the photographs it will be seen that forms were so constructed that a flat rib of additional thickness was left on top. The same was true on the bottom.

The operating pressures in this system are from 40 to 80 lbs. and the following table shows thickness of shell and percentage of reinforcement from various pipe sizes:

Pipe Size	Thickness of Shell	Area Reinforcement Per Lineal Foot
6 inch	2½ inches	.068 sq. in.
12 inch	3 inches	.096 sq. in.
18 inch	3½ inches	.153 sq. in.
24 inch	4 inches	.153 sq. in.

The average cost of this work in 1920 was slightly higher than general average because work done was in small units. Costs in 1920 were: 23-in., $4.23 per ft; 12-in., $2.16 per ft.; and 6-in., $1.29 per ft.

Such has been the success of this system that on future work—and there remains a great mileage to be repaired or replaced—it is the company's intention to make no deviation from the former work.

The greater portion of the work has been under the direction of J. F. Covert, engineer for the corporation, and to whom I am indebted for the data contained herein.

Measurement of and Estimating Concrete

Considerable interest displayed in the subject of measurement of and estimating concrete for contractors and engineers resulted in the calling of a separate group meeting at the January, 1923, convention of the American Concrete Institute.

It was pointed out by Leslie Allen, chairman, that some 10 years ago a committee was appointed by the Institute to draw up methods of measurement of concrete work and that the committee presented a partial and a final report, the final report being adopted in 1913. In discussing this subject, the Board of Direction concluded that this discussing methods of measurement, only, did not get very far because it was so much wrapped up with the whole subject of how measurements are established, how cost is estimated, and how the work is measured, and estimating costs leads into the further subject of how the costs are kept track of in order to use them in estimates.

The group meeting was called in order that contractors, engineers and others interested in the subject might have a general talk without any formalities, about the whole subject, and to see whether it was advisable to have a committee work on the subject during the year and report to the next convention for the guidance of contractors and engineers generally.

A paper read by G. W. Ginder, office of Supervising Architect, Washington, D. C., was abstracted in the February issue of Concrete, and the paper presented by Frank R. Walker, Chicago, on "Estimating and Cost Keeping", is abstracted elsewhere in this issue.

A committee will be appointed to carry on the work on this subject.

Keeping Up Concrete Pipe Quality

The importance and the actual return value of vigilance as to quality of concrete pipe was emphasized by Ernest F. Bent, California Glazed Cement Pipe Co., Los Angeles, Calif., at the recent convention, January 18 to 20, of the American Concrete Pipe Association.

"Every one of our plants has testing equipment," said Mr. Bent. "Maybe we are foolish. We may be crazy on the subject of testing, but this means we can keep a line on the product turned out. You often find things that surprise you. Often in testing you find that your own product is not doing what you thought it was.

"The city of Los Angeles does more testing of sewer pipe than any other city in the country that I have been able to learn of and I believe more than all others combined. Every delivery of pipe, whether it be 200 ft. or 50,000 ft., has six joints of pipe tested for each 1200 ft. delivered. You will see, this requires a very vigilant watch on the part of the manufacturer.

"You may be interested in the results of the tests on clay and concrete sewer pipe in the Los Angeles city laboratory, for the months of November and December, 1922: Of 6-in. pipe there were tests of 46 complete deliveries of concrete pipe, 24 deliveries of clay pipe. Of the concrete pipe there were no failures, of the clay pipe there were 11 failures due to percolation and 4 failures due to crushing; of 144 absorption tests on concrete the average was 5.1% and of 57 absorption tests on clay, the average was 6.1%. Maximum concrete absorption, 7.4%, maximum clay, 10.2%, minimum concrete 2.5%, minimum clay 3.6%. Of 8-in. pipe there were 14 complete tests of concrete, of which in one lot one pipe failed on crushing and one failed on percolation. (These failures were due to the forced early delivery of green pipe). The absorption tests averaged 5.1%, maximum 7.5%, minimum 2.7%. There were no deliveries of 8-in. clay pipe in these months. On the 10-in. pipe there were 2 complete deliveries of concrete tested, no clay; no failures, average absorption 4.2%, maximum 5.7%, minimum 3.3%. 12 in. pipe, 6 complete deliveries of concrete pipe, no clay. Average absorption tests, 4.8%. Maximum, 7.2%, minimum, 3.2%.

"The absorption test is determined by oven drying to constant weight and 24 hour immersion in cold water."

Mr. Bent said he was becoming more and more thoroughly sold on the value of the American Concrete Pipe Association. "Individually, we could not hope in a thousand years to accomplish what we are collectively not only able to do but are doing. The annual report of the secretary shows not only great progress in the general building up during the past year, but also considerable evidence that much has been done in actual, positive accomplishments in sales and adoption of specifications in new cities, which lead to sales. Not only is it possible for achievement collectively that is not possible as individuals, but I know we are all feeling very keenly the positive value of cooperation among the members by the interchange of ideas and experiences from standpoints of both production and marketing."

Agree on Higher Drain Tile Quality

Sixty manufacturers of concrete sewer and culvert pipe and drain tile attended the convention. The attendance at the special public session on the afternoon of January 19 was over eighty, including a number of prominent engineers.

More than 20 prominent manufacturers of drain tile, principally from Minnesota, Iowa and Wisconsin, agreed on certain changes in Standard Specifications for Drain Tile of the American Society for Testing Materials. In order to keep pace with the progress in manufacture, it was thought desirable to make these changes, intended to assure the consumer of better grades of tile. At a meeting of Committee C-6, Drain Tile, of the American Society for Testing Materials, held in Chicago, January 19, these changes were acted on favorably.

The Culvert Pipe Committee of the association met and discussed the recent report of the Joint Concrete Culvert Pipe Committee, which has under preparation Standard Specifications for Railroad and Highway Culvert Pipe. The Joint Concrete Culvert Pipe Committee consists of two representatives each of the American Concrete Institute, American Association of State Highway Officials, American Railway Engineering Association, American Society for Testing Materials, American Society of Civil Engineers, Bureau of Public Roads, U. S. Department of Agriculture and the American Concrete Pipe Association. Dean Anson Marston of Iowa State College, representing the American Society for Testing Materials, is chairman. The secretary of the American Concrete Pipe Association is also secretary of this committee. Considerable progress was made at the meeting of this committee which was held on January 20 in Chicago.

Rapid Progress in 1922

The address of President A. N. Shearman at the opening of the convention dealt largely with the work that has been accomplished by the association during 1922. He outlined the history of the organization, advising that it was first organized in 1908 at Ames, Iowa, as the Interstate Cement Tile Manufacturers' Association. Mr. Shearman emphasized the important work that has been carried on by the association from a national standpoint, particularly the work that has been carried on in connection with committees having under preparation specifications for drain tile, sewer and culvert pipe. One of the most significant phases of his address was the optimistic outlook for the industry in the years to come. Regardless of the propaganda that has been circulated by our competitors, the industry has taken a greater stride forward in 1922 than in any previous year of its history. The concrete pipe manufacturers are selling their product on its merits and he emphasized the fact that pipe producers have made rapid progress in improving the quality of their product to meet the most exacting engineering requirements.

G. E. Warren, treasurer of the association, submitted a favorable report on the association's financial situation.

N. A. Epps, Gulf Concrete Pipe Co., Houston, Tex., advised that not only the city of Houston, but surrounding towns have opened their specifications to machine made concrete sewer pipe.

Testing Tile in Minnesota

Roy H. Allison, consulting engineer, Minnesota Concrete Pipe Manufacturers' Association, Mankato, Minn., described the work that has been carried on by his organization in 1922. Mr. Allison paid special tribute to the work of Dalton G. Miller, representing the U. S. Department of Agriculture in Minnesota. Specimens of tile are frequently sent to St. Paul where Mr. Miller has his headquarters and tests are made at small cost to the manufacturers. This work, according to Mr. Allison, has had a tendency to improve the quality of tile being manufactured in the state of Minnesota and the responsible manufacturers of concrete drain tile are cooperating with Mr. Miller to the fullest extent. According to Mr. Allison, the drainage engineers in the state of Minnesota have adopted the standard specifications for drain tile of the American Society for Testing Materials and all tile furnished for state work is required to pass these specifications. In fact, the requirements for absorption in Minnesota are more rigid than those set forth in the standard specifications.

Better Culvert Pipe

S. A. Swanson, vice-president, Mid-State Construction Co., Hastings, Nebr., described the development of the concrete culvert pipe business in Nebraska, emphasizing the importance of testing concrete culvert pipe, not only for the protection of the consumer, but for the protection of the responsible manufacturers. He related the experiences of his company when the State Highway Department of Nebraska in 1922 required that every plant furnishing pipe for state work should install suitable testing equipment. Prior to this time, according to Mr. Swanson, he was positive that the pipe his company was producing would meet the most exacting requirements, but he found, however, that it was often running as low as 10 per cent under the requirements. By studying the data published by the Structural Materials Research Laboratory on the control of water in concrete mixtures, his company was able to produce pipe of a much greater strength without additional cost. The step taken by the State Highway Department also stopped the work of irresponsible manufacturers of concrete culvert pipe, which disclosed the very few failures that have occurred in Nebraska. Mr. Swanson advised that approximately 75 per cent of the culvert pipe sold in Nebraska during 1922 was reinforced concrete.

Prof. D. A. Abrams and Mr. Stanton Walker, his associate engineer, of the Structural Materials Research Laboratory, presided at a special session devoted to manufacturing problems at which practical manufacturing assistance was developed from work that is being carried on by the Laboratory which is under the direction of Professor Abrams.

At a session attended by many prominent engineers, Dean Anson Marston of Iowa State College, who is also vice president of the American Society of Civil Engineers, delivered an address on the vast experimental work that has been carried on under his direction. His talk dealt largely with the performance of pipe under various loading conditions in different classes of soil. As heretofore mentioned, Dean Marston is chairman of the Joint Concrete Culvert Pipe Committee. He is also chairman of the Committee on Drain Tile and a member of the Committee on Sewer Pipe of the American Society for Testing Materials.

Langdon Pearse (Sanitary Engineer of the Sanitary District of Chicago and senior member of the firm of Pearse, Greeley & Hansen, Chicago), described the engineering developments of the Sanitary District. He described some of the larger sewers that have been built which range in size from 6 ft. to 23 ft. internal diameter, with illustrations of various methods of disposing of sewage in the district, which has had such an important bearing on the development of Chicago. After his address, which was necessarily of a general nature, he was asked questions regarding the performance of concrete for sewer construction. He advised that the Sanitary District of Chicago receives alternate bids on different types of construction, generally monolithic concrete and brick. As concrete construction is usually from 10 to 20 per cent cheaper than brick, the district has used concrete almost exclusively for building its comprehensive system. He also related the outstanding advantages of concrete from a structural standpoint. He advised that analyses of the sewage of Chicago and vicinity have always shown a slight alkaline reaction, and to his knowledge no harmful trade wastes have been encountered that could be expected to affect concrete of good quality. He related, however, one instance where improper ventilation and construction had caused the disintegration of a sewer above the floor line. He stated, however, that any class of construction would have been affected by this extreme condition.

W. G. Chace, president of the Canada Lock Joint Pipe Ltd., 65 Pleasant Boulevard, Toronto, Canada, formerly chief engineer of the Greater Winnipeg Water Supply District, Winnepeg, Canada, described with illustrations various water supply lines that have been constructed by the Lock Joint Pipe Co., and the centrifugal method of making concrete pipe which has recently been introduced in this country. His company has recently secured two jobs in which this class of pipe will be used, one at Greeley, Colo., requiring 18,000 ft. of 27-in. pipe and at East Orange, N. J., requiring 8,000 ft. of 20-in. pipe. He also advised that his company has recently secured a contract for the Spavinaw Water Supply Line at Tulsa, Okla., requiring 52 miles of 54-and 60-in. reinforced concrete pipe. Mr. Chace also described the various expansion joints that were patented by his company which are used in the construction of water supply systems. Pipe are usually produced in 12-ft. lengths in order to minimize the number of joints.

A. N. Shearman, president, Shearman Concrete Pipe Co., Knoxville, Tenn., was reelected the association's president by unanimous vote. The reelected vice-presidents are: Ernest F. Bent; A. M. Hirsh, president, Lock Joint Pipe Co., Ampere, N. J.; Harry Cain, Minnesota Pipe & Tile Co., Mankato, Minn.

New members of the Executive Committee are as follows: C. H. Bullen, Concrete Pipe Co., Board of Trade Building, Portland, Ore.; G. G. Robinson, Independent Concrete Pipe Co., Harbor Administration Building, Toronto, Ontario, Canada; G. E. Warren was reelected treasurer and M. W. Loving, secretary.

Review of Concrete Pipe Progress

From the report of M. W. Loving, secretary, the following high lights are gleaned with reference to 1922 progress in the use of concrete pipe for sewerage, drainage, culverts, irrigation and water supply:

(Continued on page 121)

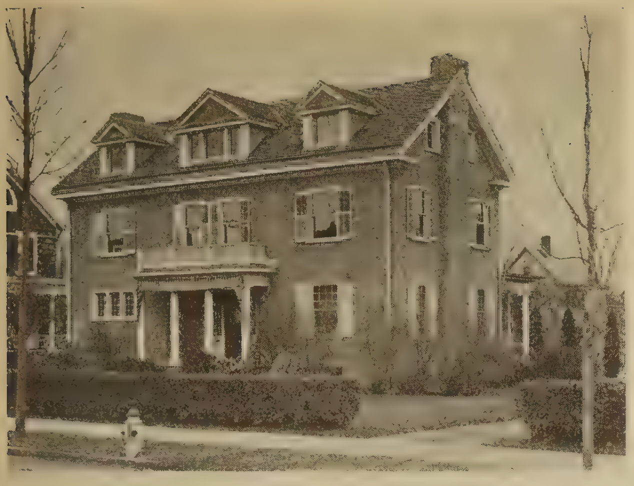


Fig. 1—Built of Concrete Block—A Satisfactory Home for Thirteen Years

Thirteen Year Test of a Concrete House

By Philip Sellers

Engineer and Architect, New Haven, Conn.

It was back in the summer of 1908 I decided to pay rent no longer, but to build a home, and I determined to set the pace in modern construction by erecting a house that would not burn from the inside or take fire from a possible conflagration from the outside.

After purchasing a lot, completing plans and delivery to the site, forms and reinforcing steel work started. Excavations of cellars adjacent to the land on which I intended to build, at 227 McKinley avenue, revealed the fact that there was sand and gravel of a suitable quality for the purposes desired.

The specifications were drawn to suit the conditions. The basement walls were made of 1:2½:5 concrete and 14 in. thick, using wood forms, in the same manner that has since become quite common, but was then very unusual.

The first and second story walls were built of concrete blocks 10 and 8 in. thick, respectively. My idea of a concrete block wall was one with the greatest structural strength and with suitable surface to receive a stucco finish. Also, one which could be produced most rapidly and with ordinary labor. The blocks were made with a Hercules block machine, the cement, sand and gravel being mixed in the proportion of 1:3:6. Several tests showed the gravel to contain about 50% sand, so that the gravel was not screened, but used as excavated in the proportion of one part cement to six parts of gravel. The blocks were made semi-wet, that is, with just sufficient water to hold the mass together and permit a slight slump. The mold was removed immediately after the block was finished. The result was a block of some irregularity but of great density. These were laid up in the wall with ¾-in. joints of 1:2 portland cement mortar. The use of a thick joint made the laying of the block very rapid, as it was not necessary to lay them true to level because any difference was made up in the next course. The end joints were sometimes widened out to over an inch to make the blocks fit a certain space, and practically no short lengths were used. Where joints could not be widened enough, the open space left between the blocks was filled with concrete, placing a board on either side of the wall to hold it in place. If the courses did not come up to the proper height for the next floor level, the difference in elevation was cared for in pouring the floor slab. The exterior was finished with a half-inch thickness of stucco made of one part cement, three parts sand and 10% hydrated lime. Immediately following the application of the stucco, pebbles from ¼ in. to 1 in. in size were thrown onto the surface. (See Fig. 3). These pebbles stand out in bold relief, as seen close up, but at a distance of 20 ft. the appearance is very pleasing, giving soft tones of Arabian browns and dark red colors.

No special waterproofing was used in either blocks or the stucco. This gives a natural appearance to the surface, as the color varies from day to day with the atmospheric conditions, as natural stone does. On very dry days the stucco is light colored, and the dark pebbles taken from the excavation give a contrast. On damp days and in the rain the stucco gets dark colored and the white and yellow pebbles again give a very pleasing contrast. These light colored pebbles were secured by buying regular roofing gravel and screening into two sizes, the larger used for stucco, while the smaller were afterwards used in walks, making them almost match the house.

A feature of unusual interest is the rustic effect obtained in the roof design. It is probable that this house is one of the first in New England to be roofed with portland cement shingles. These were made on wooden

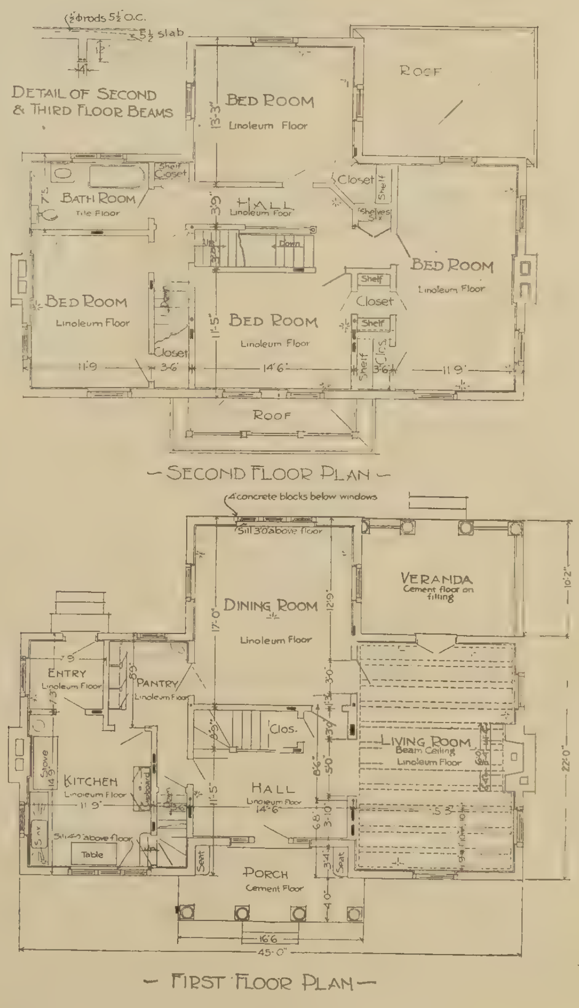


Fig. 2—Floor Plans Sellers

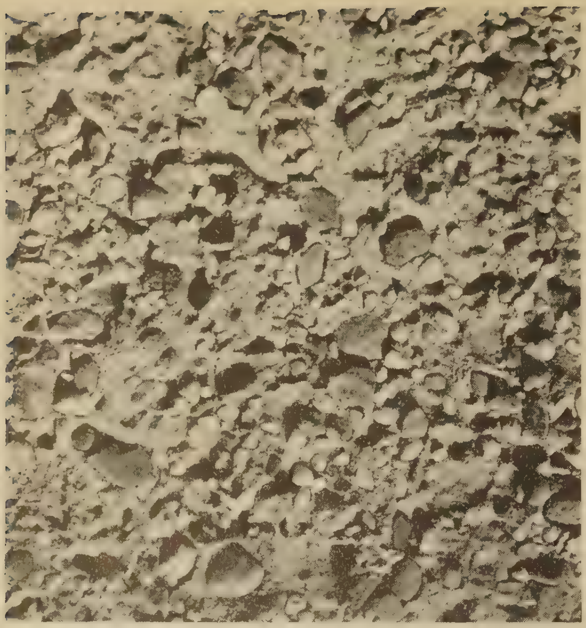


Fig. 3—A Close-up of the Stucco Surface

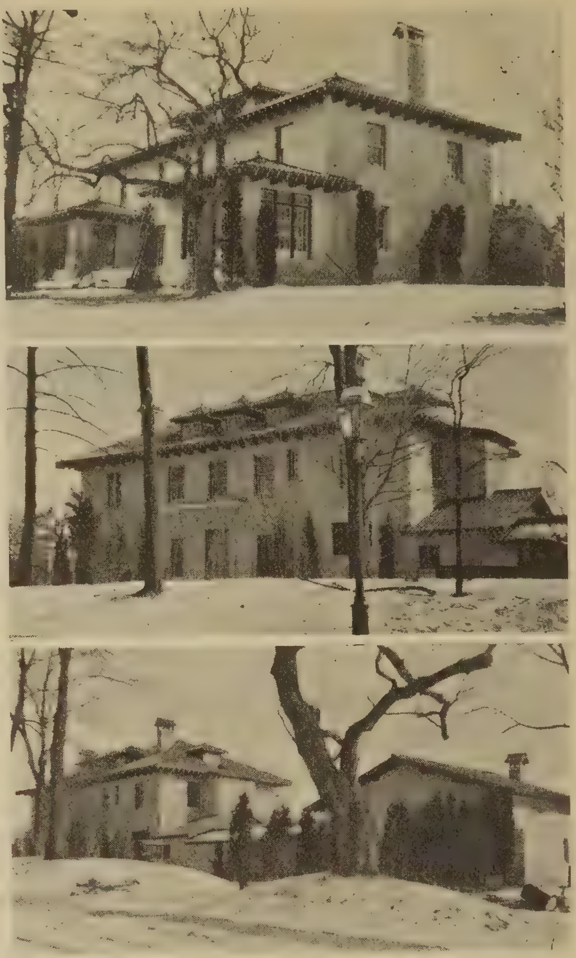
pallets, at the site, being 12 in. by 8½ in. and tapering from ¾ in. to ⅜ in., and reinforced with common 1-in. mesh chicken wire, although some ran slightly over the standard thickness.

The wire was placed on the pallet, mortar put in and the excess removed by drawing a plastering trowel over the screeds at the sides. This formed the shingle to the correct thickness and produced a smooth surface. Then a dash of portland cement and special metallic red color of creamy consistency was thrown on the surface and smoothed with the trowel. This color was only applied to the butt and care was not taken to cover all of this, as to some extent an irregular coloring was desired. After the shingles had partly hardened, a man went around and made two nailing holes in each shingle about three inches from the end. The shingles were laid on the roof, in a bed of mortar, about six inches to the weather. It is interesting to note that this roof has never showed any sign of a leak and the colors on the shingles in aging have developed most pleasing rusty color combinations.

The first floor is concrete 3½ in. thick, reinforced with 5/16-in. rods and carried on reinforced concrete beams 12 in. by 10 in., supported at two points on concrete columns and having a clear span of 14 ft. The second and third floors are 5½-in. slabs, carried on reinforced concrete beams 4 in. by 18 in., which become part of the partitions. All floors are covered with heavy linoleum of a dark brown. This is easily kept clean and provides an excellent surface for rugs and furniture. All exterior walls were furred, lathed and plastered. Ceilings were finished by applying gypsum plaster directly against the concrete.

The cellar was excavated to a depth sufficient to supply all the sand and gravel for concrete work, roof shingles, stucco and plastering. Work was started in November and we moved into the house in April, thus completing the house in comparatively quick time and in the winter months. Heat was furnished by salamanders, and retained by canvas enclosure.

The house has been occupied continuously by me and has always been warm and dry. The structure has needed no repairs of any kind. Twelve tons of coal is sufficient for heating it in an average winter.



Figs. 1-3—The Cinder Block Double Wall House of R. H. Cochrane at New Rochelle, N. Y.

Large Cinder Block House for R. H. Cochrane

The house of R. H. Cochrane, New Rochelle, N. Y., shown in the accompanying pictures and nearing com-

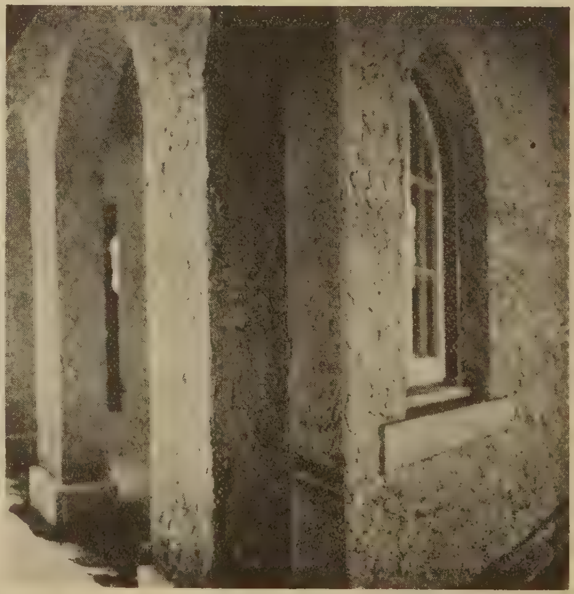


Fig. 4—Stucco Surface of Cochrane House

pletion, is built of cinder concrete block 1:5 mix, cement and cinders with some sand, by the Cordery System. The walls are 14 in. thick, having an 8-in. block inside, a 2-in. air space and an inner 4-in. block, plastered direct inside and stuccoed outside to a thickness of 1 in., the finish having a yellow coloring. The texture is unusual as shown by the detail, evidently obtained by applying the stucco in small unfloated "dabs." All sills, lintels and trim are of concrete made at the job. The building is 66 by 34 ft. in plan, two stories, basement and finished attic. In the stair hall the floors are of 8-in. x 8-in. x 16-in. cinder block supported on concrete beams and covered with 7/8-in. slabs of Travertine marble. The architect is E. O. Fallis, Toledo, with John R. Fallis superintendent. Mr. Cochrane, the owner, is of the Universal Film Co.

SOME OF THE HOUSES BUILT BY FRANCIS F. WILSON, ROCKVILLE CENTER, L. I. CONCRETE WALLS AND FLOORS

Fireproof Houses Built by Francis Wilson

The pictures show something of the character of permanent fireproof suburban dwellings being built by Francis F. Wilson, Rockville Center, L. I., who has been a house builder since 1891, in recent years concentrating on the monolithic concrete home.

"It is not difficult to construct a concrete home," says Mr. Wilson. "Small mixers, hoists, etc., can be readily secured and will last a long time. The greatest single item of equipment is, of course, the forms, and in this matter I have had considerable experience. Some forms have innumerable small pieces, some are too heavy, some intricate, and almost all are a source of expense to transport from place to place.

"I am now using a system invented by Frank D. Lambie, New York city. It is simplicity itself, being nothing more than a steel skeleton, though very rugged. It is so designed that the skeleton form is set up for the complete building at one time, all walls and floors. The inner and outer forms are lined with the most easily obtained and cheapest of lumber. I am using ship-lap, and after stripping use the ship-lap for roof sheathing. All reinforcing, rough plumbing, window and door frames are placed in the wall space as the lining is placed, all the forming is done at one time, as is the pouring. The whole cycle (two stories and basement) can be completed with a crew of six men in three weeks—the complete shell of a modern six-room and bath dwelling erected in three weeks.

"In using the story-at-a-time system, as I have done, one must have, say, 10,000 sq. ft. of forms; my old equipment was two carloads and weighed 42,000 lbs. The new equipment weighs but 12,000 lbs., and can be moved easily by motor truck in a very short time. Much time and labor is thus saved, in consequence a reduced cost.

"We are getting our plans completed for the erection of a number of thoroughly modern houses, fully equipped with all the latest bath and kitchen appliances, electrical conveniences, steam heat, etc. The aggregate will be wholly local, also the lumber; the cement is near New York city. These houses will be fire-safe, artistic, comfortable and have an intrinsic value unobtainable by any other method. The sale price, exclusive of land value, will be $8,500."

If you have just solved a difficult problem, trade your ideas with the other fellows.

Concrete House That Is All Concrete

By H. F. Tyler
Dewey Portland Cement Co.

Many of the concrete houses that we read about are only part concrete—that is, they have concrete walls and basement floor, the balance of the building being frame, and the vulnerable parts being of such construction that fire could easily ruin the entire building. The writer knows of a number of concrete houses with wooden floors, wooden joists, and with roofs sheeted with lumber on wooden rafters, and then covered with tile or slate roofing. These are commonly referred to as fireproof concrete houses, although they are not fireproof. The writer's house is constructed entirely of concrete, from the basement floors to the roof slab, the only wood in the house being in the doors, window sashes and frames. This house has proved to be remarkably cool in summer and warm in winter, and although the neighbors frequently speak of wind storms, we do not know of them if we remain indoors.

The walls are double, the outer wall being 6 in. thick and the inner wall 4 in. thick, with a 2-in. air space between the two. There is about ½ inch of plaster on the outside of the outer wall, and on the inside of the inner wall, making the total thickness of the wall 13 in.

The floors and roof are of concrete, beam and girder construction, with a 4-in. slab on top of the girders, making a monolithic construction. The flat concrete roof slab has just slope enough to carry off the water, and this in turn is covered with a composition roofing. The roof garden, which surrounds the sleeping rooms located on the roof, has a 2-in. concrete slab on top of the composition roofing, to take the wear.

The forms used in construction of the walls were made of wood on the ground, and after being removed were afterwards used for staging and similar purposes. The forms for the floors and roof, as well as all beams and girders were metal dome forms. The walls were poured in courses about 11 in. high and ¾-in. x 12-in. boards were used for both the outer and inner faces of the form. A 2-in. x 12-in. piece, placed in the center of the form, served the purpose of a core in producing the hollow wall effect. This core was made slightly tapering towards the bottom edge, so that it could be easily lifted by means of loops of wire attached to each end of each piece.

Concrete of a dry mix was used and no effort was made to tamp it, but on the contrary it was left porous, so that the plaster would key to it.

The mix consisted of four parts of limestone, ranging from 1½ in. to ½ in., two parts of coarse sand, and one part of portland cement. The mixing was done in a gasoline driven Lansing mixer, which poured into a bucket. Concrete was spouted as far as it could be spouted to convenient points, where the laborers placed it in the wall forms with shovels. For the floors and roof the spout was swung along so that very little wheelbarrow work or shoveling had to be done. The floors and roof were poured of an ordinary mixture, so as to flow better than the wall mixture. The stiff mixture for the wall was not tamped into the forms, and an effort was made to leave plenty of voids for the plaster to key to.

Figs. 1-2—The Tyler Fireproof Home, Outside and Inside

The forms were held true by 2-in. x 8-in. and 2-in. x 10-in. planks, nailed together at all corners and openings, and these were placed plumb. Hence every time the forms were moved it was not necessary to plumb them. Where the spaces were over about 8 ft. long, we had eccentric clamps that kept the forms from spreading.

About two hours after each course had been poured, the carpenters lifted the forms, beginning at one corner and working around the building. As soon as the forms were lifted, the laborers again filled them. On several days 46 in. in height of wall was poured per day.

Deformed reinforcing bars were used for the beams and floor slab. For every foot of height in the walls a ⅜-in. rod was laid in , and after that 1-ft. course was poured, both for the inner wall and the outer wall, and

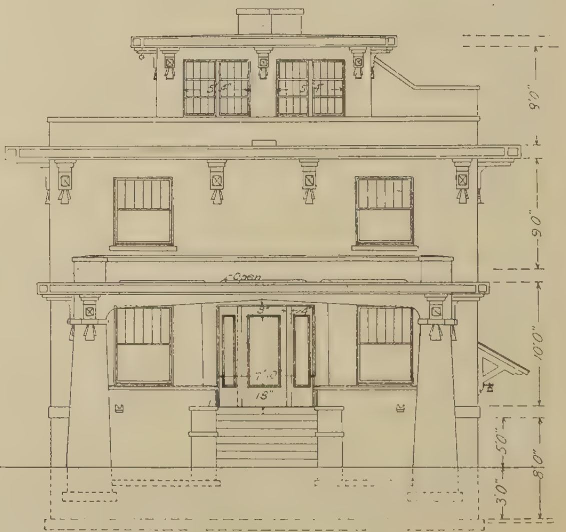


Fig. 3—Front Elevation of the Tyler House

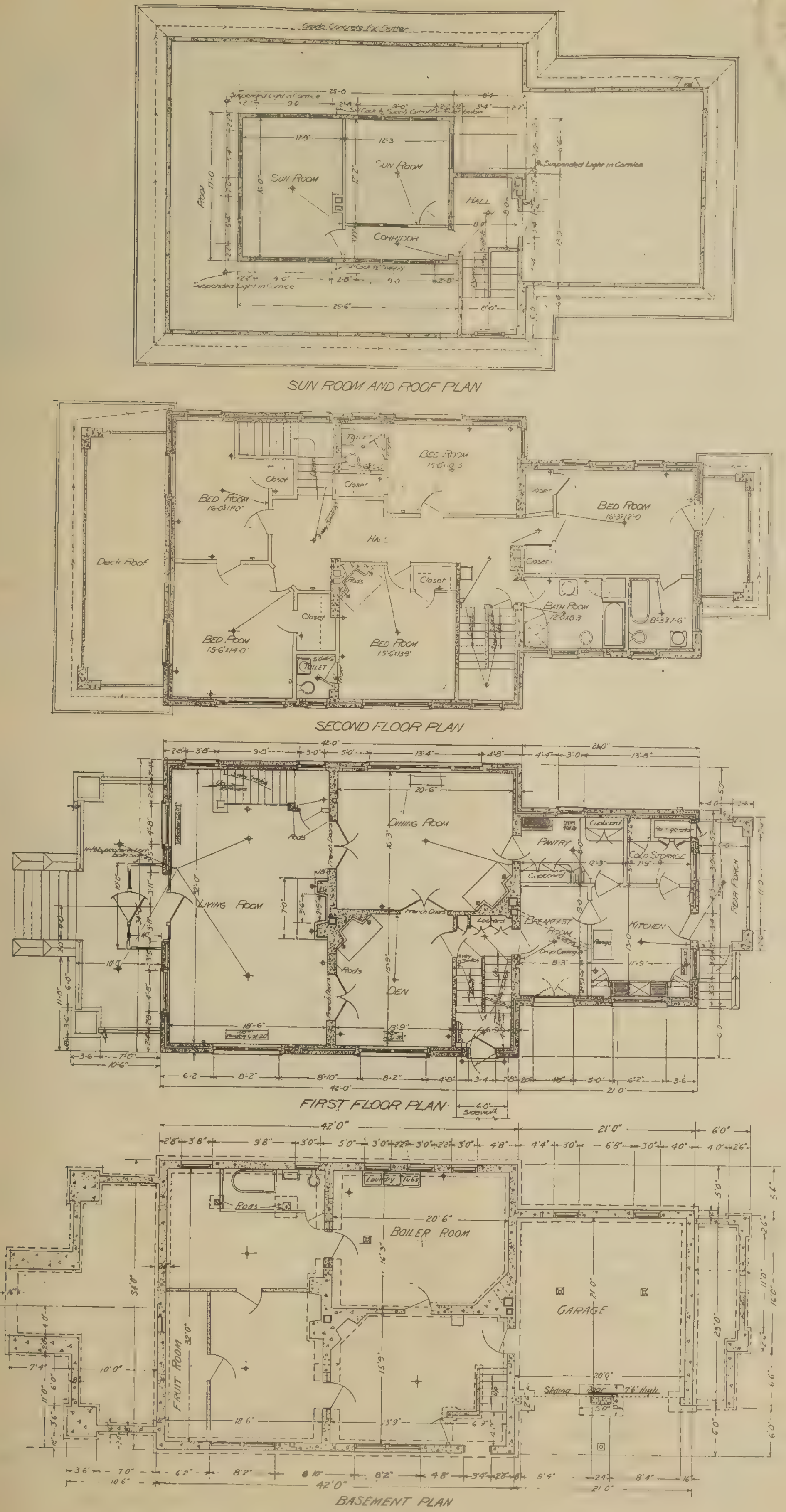


Fig. 3—Floor Plans of Large Fireproof Home of H. F. Tyler

after the 2-in. core was pulled, pieces of ¼-in. galvanized rod bent in the form of a "Z" were laid in the concrete to tie the inner and outer walls together. We also used vertical rods in a great many places, spaced about 8 ft. apart, which were continuous from the footing to the roof, and in fact nearly 50% more steel was used in the job than the engineers claimed was necessary.

The window sills and lintels were neglected when the walls were run, and were cast afterwards. They were trued up by the plaster. The keystone shaped ornaments under the cornice were precast and braced temporarily until the concrete plaster set that held them in place.

The building site is located about 18 in. above the street level. Of the five rooms in the basement, one is a two-car garage. The cars go down an easy incline, just steep enough to prevent thieves from pushing an automobile out, as they usually do. The other rooms in the basement are used as follows: one for the vapor steam heating plant, another as a work room, another as a laundry, and another as a storage room. The storage room has a dark but ventilated fruit room adjoining it.

The first floor contains the living rooms, as are ordinarily laid out in residences, and it will be noted that the breakfast room is very convenient to the kitchen. The pantry and refrigerator room are also convenient to the kitchen.

The second floor contains nothing of unusual interest. It has five bedrooms, each with a convenient closet. Two of the bedrooms have private toilet rooms, and one has a private bathroom.

Rather than build the sleeping porches on one or more sides of the house, the summer sleeping rooms were located on the roof, and there are three of these with abundant windows. They are surrounded by the roof garden.

Mrs. Tyler is a farmer-woman who is a real housewife, and her instructions to the architect were largely carried out in planning the house. When it was proposed to build a house with a flat roof, the architect laughed at the idea, saying that he did not want to design a house that looked like a store. However, his preliminary sketches were made, it being our idea that with wide eaves and a third story set-back, the house would present a satisfactory appearance.

The interior walls are covered with paper, with the exception of walls like the kitchen, pantry and bathrooms. These are painted. The doors and frames are of red oak, finished with natural varnish.

The house was built at a time when it was very difficult to carry on building operations. Help was scarce and independent. Material was hard to get. The cost of the house was just about the cost of a good brick house.

Walton Everman, Bartlesville, Okla., was the architect who made the plans, and Arthur Gorman, Bartlesville, had charge of the construction work. The writer put in a few hours every day helping out with the work.

If some question about concrete bothers you, ask the Editors of CONCRETE. Maybe they can find the solution.

Economical Type of House of Block and Stucco

This colonial type house, 31 ft. x 24 ft. in plan, was designed by Don A. MacLaren, Minneapolis architect, for Charles Birdsell of that city and has just been completed. The walls are of plain concrete block covered with portland cement stucco without ornamentation further than the wooden trellis strips.

Mr. MacLaren, who was one of the successful architectural contestants at a recent concrete show at St. Paul, exhibited there a house along quite similar lines, which appealed so strongly to Mr. Birdsell that the architect was engaged to prepare the plan. This plan was later selected by the Portland Cement Association as one of the initial designs presented in its house plan service.

Simple rectangular shape makes for economy of construction, giving maximum room space at minimum cost. The exterior and bearing walls, from the shallow footings up to the eaves line are of standard 8-in. x 16-in. plain concrete block, 12 in. thick below grade and 8 in. thick above grade. The block specified have flat rough surfaces making an ideal base for a cement mortar coat below the grade and portland cement stucco above. So far as carrying ability is concerned the walls are excessively strong, being calculated to carry about 750 lbs. to the sq. in. while the entire weight of the building and contents is not over 20 lbs. to the sq. in. In accordance with good practice for house wall construction of all masonry materials, furring and lath are used on all exterior walls before applying interior plaster.

Masonry materials used in the house were:

Monolithic concrete for footings, 7 cu. yds.

Reinforced concrete slabs for front entry and rear porch floors, 4 cu. yds.

Block for foundation walls (8-in. x 16-in. surface, 12 in. thick), 750 whole and 96 half block.

Block for ell and porch foundations and basement partitions (8 in. thick), 350 whole and 96 half block.

Block for walls above grade (8 in. thick), 1,636 whole and 262 half block.

Block for joist course 8-in. x 8-in. x 16-in. with joist recesses, 71 whole and 8 half block.

Block, special jamb shapes, 8 in. thick, 80 whole and 80 half block.

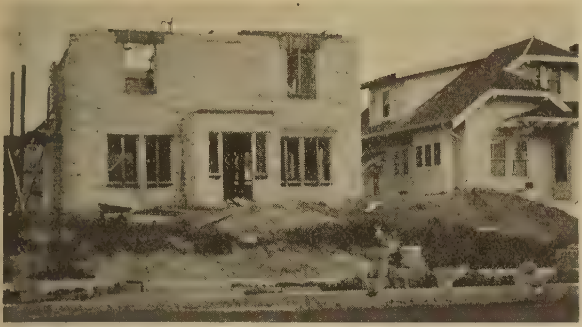


Fig. 2—The Charles Birdsell House Under Construction

Block for area walls, rear entry and coal bin walls (solid block 8-in. x 16-in., 4 in. thick), 399 whole and 90 half block.

Lintels, 27, precast, 8-in. x 8-in., reinforced.

Window sills, 13 precast, average length 5 ft. 5 in.

Thresholds, 5, precast.

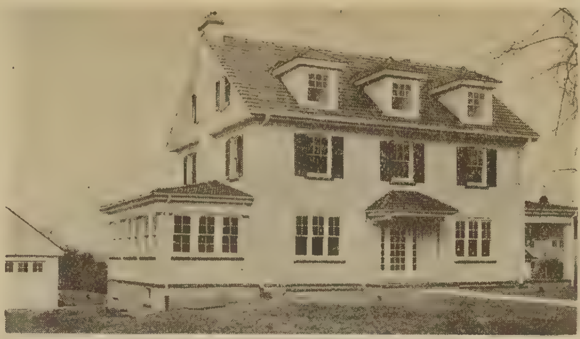
Concrete or brick for front step.

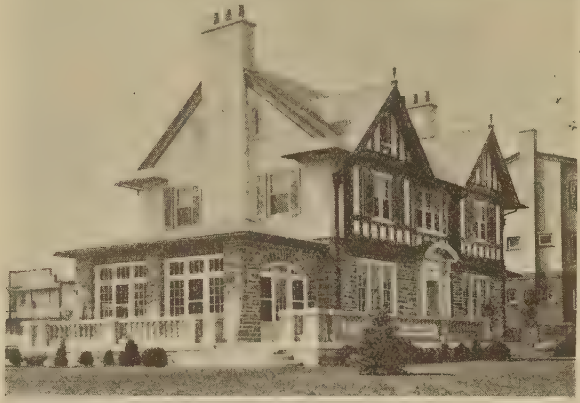
The exterior plaster work covers about 293 sq. yds. of surface, 242 sq. yds. being on concrete block and 51 sq. yds. on metal lath.

Specializes in Porch and Garden Work

Julius Ruoff, Ruoff Construction Co., Philadelphia, specializes in the restoration of porches and similar work. He makes garden furniture and, in fact, has built up a business by watching for opportunities that present themselves for garden and porch beautification. He keeps an eye on the old houses.

A recent job, part of it shown in the picture, totaled more than $4,100. This work includes two concrete porches, with concrete columns; copings on 110-ft. front on Rising Sun avenue, and 300 ft. on the intersecting street; pavement, driveway and several sets of concrete steps. The columns, porch enclosing and posts were made in rough granite finish of a mixture of 1 cement to 2½ granite screenings, on the surface. The porch floors are reinforced, have black borders and red color in center, laid out in 12-in. x 12-in. flags. All the work was done on the job, except the columns, which were set after the porch had been finished.





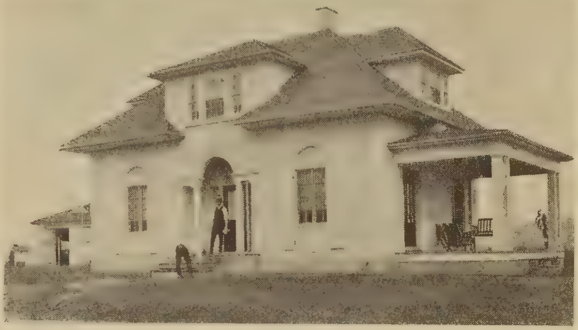


Fig. 1—Residence of Charles Russ, West Main St., Haddonfield, N. J. Erected by William Congezer & Son Co., Inc., Haddon Heights, N. J.

Fig. 2—Residence of Christ Kunzler, West End and Buchanan Aves., Lancaster, Pa. First Floor of Stone, Second and Third Floors Constructed of Straub Block. Half Timber Work Nailed to the Block Without the Use of Wooden Nailing Strips. Frank Roschel, Contractor; D. Emlen Urban, Architect.

Fig. 3—Residence at York, Pa.

Cinder Block of Increasing Popularity for House Construction

Cinder concrete block are becoming more and more popular for walls of dwellings. They are not as strong as well made gravel or stone concrete block but masonry strength for average residence uses is a minor consideration. When residence loads are only 20 or 30 lbs. to the sq. in. of wall and cinder block test 750 lbs. the factor of safety is far in excess of requirements. The advantages are lightness of weight; improved insulating values; good base for stucco which provides an exterior waterproof seal; fire resistance and facility in nailing. The houses shown in the accompanying pictures are built of Straub patent process cinder block.

Figs. 1-2—New Gleason Houses, as Sketched

New Gleason Houses Have Unusual Features

The work of Miss Kate Gleason, engineer, in building about a hundred concrete houses at East Rochester, N. Y., has been given a good deal of deserved attention in this magazine. Miss Gleason as a builder is full of surprises. She doesn't stagnate as so many builders do in a blind adherence to tradition. From the very first she tossed tradition out of the back door and built small—quite small—houses of fireproof material and sold them lot and all (at a profit) and with the kitchen furnished complete, for $4,000. And while the houses are very small *as houses,* they are very spacious and airy as compared with the pinched and stuffy apartments that a good many people live in—the people for whom her houses were intended.

She has accomplished the unprecedented in costs in two ways: First, by organization of a crew of "house-builders," being so situated as to be able to ignore the score or so of *trades* which keep house costs higher than they ought to be. We need a trade of *House-builders* elsewhere than in East Rochester. The other way to low costs was by elimination of nonessentials. Every part and detail of a house was examined by Miss Gleason with a fresh curiosity. Those she could find no good reason for, she eliminated.

Miss Gleason hasn't done a perfect job of house-building. We predict she will put back, ultimately, some of the things she has eliminated and that she will add perhaps 10 percent. to her present costs and be better satisfied. She has given the established house-builders some valuable lessons and she is having new ideas every day. Her letters are refreshing. Let us quote a recent one about some new type houses here illustrated:

"You will notice that we first pour a concrete fence 4 in. thick and 9 ft. high. Then we lay a concrete side-walk inside the fence. After that we put on a roof. And then line the house with Linabestos.

"The rest of it is all an assembly proposition. The plumbing, the heating, the electricity, the fire-place, the closets— are all bought finished ready to install. The floor finish is linoleum. The furnace smoke pipe is carried to the roof. We escape the mason on the fire-place too because we use a good-looking copper flue which goes up to meet the furnace smoke pipe at the roof where they are joined through a Linabestos shell, through the roof. I used the exposed copper flue at Clonos, my house that I built in 1910, it is beautiful and satisfactory.

"I have succumbed to a small cellar for the heating plant. It is handy for the plumbing too on a one story house.

"And I am putting all the roof joists in the roof instead of letting 15% stick over the side. By using all of the 16-ft. sticks in the roof, I get 12 ft. to the ridge on the 21-ft. width and with such head room, a couple of extra bed rooms could easily be finished off.

"I am using Linabestos for the gable ends, hence the timbered effect shown in the 'rendering.' It is way cheaper than plastering on wire mesh with the advantage of going on in winter weather.

"Has anyone told you what a handy thing a Fordson is on a building job? We bring the sand from the pit with it. We unload our cars and it will pull trailers through the present snow-banked roads. In ordinary weather we dig our cellars with the tractor—leaving it

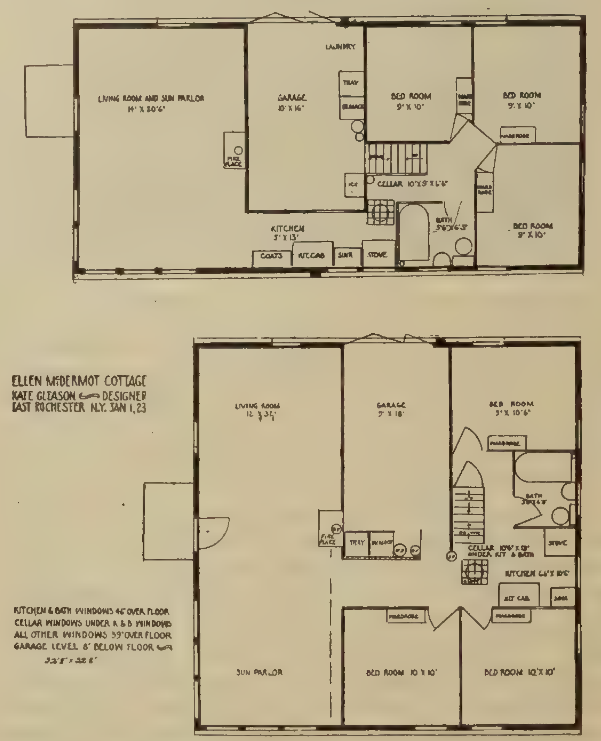


Fig. 3—Two Plans of New Gleason Houses Now Under Construction

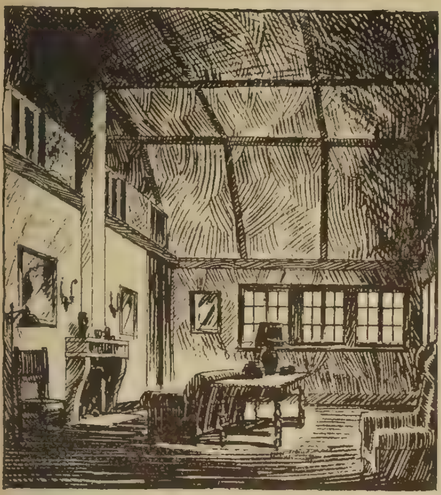


FIG. 4 — THE PARTIAL SECOND FLOOR MAY IF DESIRED BE LEFT OPEN AS A BALCONY

on the level hitched with a long chain to the plow or scraper.

"The roof is copied from the Provincetown roofs put up by the Portugese sailors who settled there. It is 12 ft. high to the ridge, giving plenty of room for a gallery or a couple of bed-rooms and yet it does not take another inch of lumber and nothing like so much time as those with the 5-ft. attics I have been building.

"How much cement do you think I use in a house 22 ft. by 43 ft. or 33 ft. by 33 ft., which are the sizes I am building this year? That's counting foundations, side-walls, floor, and a cellar 10 ft. by 13 ft. under the kitchen and bath. 25 bbls. Can anybody beat that record?

"I am calling this new design for my Mother. It is the first time that I have done anything that I considered worthy of her name. She was a pioneer in taking the laundry out of the cellar. She was too thoughtful of others' comfort to ask any laundress to work in such a place. And her ideal was a one story house."

And then in response to critical inquiry about some features of plan and construction of the new one story houses, Miss Gleason wrote:

"The floors, for instance. Did you ever have occasion to keep your feet warm on a cold drive? If so, which did you take—a piece of warm wood or a hot brick? We use two precautions to keep the moisture of the ground from the under side of the concrete floor. One is a coating of tarvia on the outside wall up to the level of the average depth of snow, and a coating of tarvia for 2 ft. inside the walls on the cinder base of the concrete floor. The other is sinking the garage floor 8 in. below the level of the house floor.

"The high open space is still simpler. The furnace we use has a 20-in. fire-pot and is guaranteed good for 12,000 cu. ft. Even if we threw in the garage and the whole attic, we would have only 11,700 cu. ft. in the house. Even when we use the gallery, we take only 10 ft. back to the stairway landing. And we don't put in the gallery often because most families buying a $4,000 house prefer the extra bed-room or storage space. I had this sketch made to show how very dressy the house can be made without extra cost.

"For the ventilation in the kitchen, I use the same plan I started with, a Polar Cub electric fan. Only now instead of putting it in the wall, I have arranged a pane of glass in the kitchen window, to open when we want to fan out the cabbage smell."

The A. C. I. Convention Question Box

The twenty questions in the Question Box were propounded by Institute members prior to the convention and were assigned to other members for discussion. A number of the questions were grouped, because they were closely related, and in such case more than one question was assigned to one member to answer. In no case was a question assigned to the one who submitted it, but further discussion was invited on the floor of the convention, where the first speaker did not use the six minutes allowed for each question.

Cinder Fill

How may cinders be used for roof fill most successfully to avoid expansion and displacement of parapet walls?

The question was assigned to L. C. Wason, president Aberthaw Construction Co. Mr. Wason's answer to the question was read and was to the effect that the best way to avoid the bad results referred to was to omit the cinder fill and place the roofing directly on the concrete slab. In the discussion of this question, the possibility of using cinder concrete to replace the dry cinders was suggested, the cost being given as about double the cost of dry cinders. One case was cited where a 1:3½ cement cinder concrete expanded sufficiently to push out the parapet wall, there being no plastic joint between the concrete and the parapet wall to take care of the expansion.

Does the saving which the use of slag entails warrant its use in reinforced concrete building?

In reply, John A. Ferguson cited results showing that the strength for slag concrete exceeded by 50% the concrete made with Pittsburgh river gravel, where the cement factor and water cement ratio were the same in both cases.

Strength, Density or Impermeability

Which of the following characteristics is most important in the making of good concrete: Strength, Density, or Impermeability? Give simple rules for attaining the desired results.

H. F. Gonnerman, Structural Materials Research Laboratory, read a discussion from which the following is abstracted:

This question is subject to two interpretations. One of these is, which of the three mentioned characteristics is the best criterion of the quality of concrete in general, and the other is, which of these characteristics is it most important that a concrete should possess? Is it more important that a concrete should be dense, or impermeable, or that it have high strength?

Strength is the measure of the ability of concrete to resist loads to which it may be subjected. Density is defined in various ways. As applied to concrete mixtures, it is most commonly defined as the sum of the absolute volumes of the solids; that is, the cement and aggregate in a given volume of concrete. It is based on the specific gravities of the cement and aggregate, the weights of the materials used in the mix, and the "yield" of the concrete.

Impermeability is the measure of the resistance which a concrete offers to the passage of water. It is frequently assumed that the absorption of concrete is a measure of its impermeability. Tests show that this is not the case. The absorption of concrete gives an indication of the amount of the air voids or pore space in the concrete to which water has access. These pores or voids are not necessarily connected and continuous, and therefore may not permit the passage of water. Materials having the same percentage of absorption may vary widely in impermeability. Although there is no direct relation between absorption and impermeability, it is true in general that these two characteristics of concrete are affected by the same factors. On the other hand, in a concrete which is permeable, these pores are more or less continuous, thus permitting water to penetrate and pass through the mass.

Density is a desirable characteristic, but considered alone, it does not indicate whether or not a concrete is of high quality. A dense concrete may be relatively weak, so far as strength is concerned. On the other hand, data obtained at the Structural Materials Research Laboratories and in other laboratories, show that compressive strength is a reliable indication of good quality; high quality being accompanied by high strength and vice versa. There are fairly well defined relations between compressive strength and other properties of concrete, such as wear, flexural strength, shearing strength, absorption, etc. If the strength of a concrete is known, other important properties of the concrete may be judged with a fair degree of accuracy. Strength, therefore, furnishes a direct and useful means of judging the quality of concrete which is not readily given by density or by impermeability.

If a concrete made with given materials has high strength, it may generally be assumed that the concrete is also relatively dense and impermeable, since the factors and conditions which affect the strength of concrete also affect in similar ways its density and impermeability.

There is no direct relation between density and strength for the wide ranges in proportions, water content of the mix and grading of aggregate. Tests show that concretes having the same strength may vary in density from about .54 to .84. When, however, certain of the variables which affect the properties of concrete are properly controlled, a fairly well defined relation will be found to exist between density and strength. For example, if the grading and mix are kept constant and the amount of mixing water varied, there will be found a direct relation between density and strength.

Although there is no relation between density and strength, when the variables are not controlled, a general relation is found between density and strength when the amount of cement in a unit of volume of concrete is considered in relation to the complement of the density, that is, to the air and water voids. There is also a very well defined general relation between the strength of concrete and water-cement ratio, the ratio of the volume of the mixing water used to the volume of the cement in the batch.

When judging the relative strengths of concrete the water-cement ratio is a more readily usable function than is void-cement ratio, since it may be determined as soon as the concrete is mixed, without having to make specific gravity tests and weighings of the materials used, and without making determinations of the "yield" of the resulting concrete.

When concrete is used in constructing reservoirs and conduits, and in structures exposed to the action of sea water, alkali soils and to the action of the weather, the impermeability of the concrete, as well as the strength, becomes important and must be given careful consideration. Due to the difficulty and expense of making permeability tests of concrete, there are not as many data available on this question as there are on the other properties of concrete. Such data as are available, however, indicate that the factors which will produce concrete of high strength, will also produce impermeable concrete.

The following rules give briefly the principal points to be observed in order to obtain concrete of high quality:

1. Use only aggregates which are clean and structurally sound.
2. Use a sufficient quantity of cement to give a smooth working concrete with the aggregates to be used.
3. Use aggregates which are well graded in respect to size of particles.

This item is important when impermeable concrete and concrete of high strength are desired. Tests made at the Structural Materials Research Laboratory show that for a given mix and consistency the strength may be more than doubled by varying the grading of the aggregate.

4. Use as small an amount of mixing water as possible to produce a concrete which can be properly placed in a dense compact mass.
5. Mix the concrete thoroughly.
6. Handle and place the mixed concrete in such a manner as will prevent separation of the aggregate and which will secure a uniformly compact mass in the forms.

This item is of more importance than usually assumed. Careless handling and improper placing of the concrete subsequent to mixing will often minimize the benefits gained by careful grading and the use of the proper cement and water content.

7. Provide curing conditions during the early stages of hardening of the concrete, which will allow the concrete to harden normally and which will prevent it from drying out prematurely.

The effect of curing condition on the properties of concrete cannot be too strongly emphasized. Concrete which is permitted to dry out in the early stages of hardening cannot be expected to show much gain in strength with lapse of time. The effect of curing condition on impermeability is fully as marked as on strength, as tests made by Professor Withey at the University of Wisconsin show. If concrete of high quality is to be secured, the handling, placing and curing, which are often considered to be of minor importance, must be given careful consideration.

F. R. McMillan suggested the following rule for making good concrete: Use as large rock as conditions permit; use as much rock as conditions permit; use as little water as conditions permit; and keep wet as long as conditions permit. These rules, it was suggested by one of the members present, should be printed in bold type and posted in every superintendent's and foreman's hat.

Safe Unit Stress at 24 Hours

Provision is usually made in all building laws for the maximum ultimate loading to which the concrete may be subjected in compression after it has attained its full strength. We frequently have occasion to apply loading to concrete which is only a few days old, sometimes by means of hydraulic jacks and in other cases by direct loading. We are always confronting the assumption that we are overloading the fresh concrete. What would be considered the safe unit stress in compression on concrete 24 hours old under normal conditions of weather and materials, assuming a 1:2:4 mix? What expedients other than those customarily employed can be used to increase the value of concrete in compression under the above circumstances?

The strength of concrete at 24 hours involves factors which do not enter into the later strength of the concrete, according to A. R. Lord, to whom this question was assigned for answer. The variations in strength of concrete where different brands of cement were used was pointed out as being one of the important factors governing 24-hour strength. Comparatively heavy loading is considered permissable in building alterations where the area loaded is small and the new concrete able to withstand higher stress.

The use of Cal to increase the early strength of concrete was suggested, and one instance cited where the use of 8% of Cal in caisson construction allowed a caisson to be pushed down in 12 hours, where previous time was three days.

Integral Waterproofing

Is the value of integral waterproofing purely psychological in its effect on the contractor?

In discussing this question, S. C. Hollister pointed out that when a contractor or foreman is instructed to use integral waterproofing, the instructions go along with the use of the waterproofing that very good concrete is to be made in order to get the proper results, and that the actual purpose of the waterproofing is not clear.

Included among the integral waterproofing compounds are the finely ground materials such as tufa or trass, about which there is some doubt as to the chemical action with the cement in the concrete. With the waterproofing which depends upon chemical processes, the principal function is to make the pores of concrete water repellent.

It was pointed out that while waterproofing may be required in some cases, to overcome defects, such as cracks in the concrete, and may also be desirable to increase the workability of the concrete without changing the consistency, where surrounding conditions are ideal by the proper mixing and placing of concrete no integral waterproofing is needed.

Applying Laboratory Knowledge

How can laboratory tests which are now being made with regard to consistency of concrete be put into practical use?

In answering the question as to how laboratory tests which are now being made with regard to consistency of concrete, can be put into practical use, W. A. Slater, engineer-physicist, Bureau of Standards, stated that in general there are two places for measuring the consistency: (1) the measuring of the proportions, and determining the mix in the laboratory, and (2) the inspection of concrete in the field to reach the conditions aimed at. Variations such as sand, water, etc., unless properly watched, may be such as to throw out the value of any test for consistency. Certain conditions are to be agreed upon and conditions in the field regulated so as to preserve the proper relation between field conditions and the laboratory tests.

R. B. Young stated that it was his conclusion that tests were impractical with the material available, and the lean mixture, with crushed rock aggregate graded up to 2½ in. used in connection with the Queenstown-Chippewa power development work. The flow table was found to be impracticable for average field conditions. Best results were obtained by limiting the amount of water to the bag of cement in the batch, and when a larger percentage of fine material necessitated additional water, proportionate cement must be added.

Corrosion of Reinforcing

Rusting of steel reinforcements in concrete construction causes the breaking or spalling off of concrete and otherwise injuring the work. What is the best method of keeping the steel from the exterior surface? How much protection is necessary? What is the best way to make repairs where this damage occurs?

The rusting of steel reinforcement in concrete construction, it was stated by M. M. Upson, gives more concern than any other question, because engineers are not careful enough in design.

The trouble generally begins at expansion joints. Various steps can be taken to prevent the rusting of reinforcements, the first being to get the engineer to design expansion joints properly; second, to keep the steel away from the surface of the concrete; and third, by binding the steel together so as to ensure that it is held in its proper place. Reinforcing steel may be kept away from the surface wtih the aid of concrete blocks that hold the rods the proper distance away from the forms.

The amount of protection necessary for the reinforcing rods in concrete depends upon the concrete and local conditions. In some instances, the steel may be allowed close to the surface, while in others it should be 10 in. back. The report of the Engineering Institution of Great Britain on structural materials in harbor structures recommends 1½-in. to 2-in. protection in harbor construction.

In precast units, the steel should be kept as near the surface as possible, and yet allow the proper protection, so as to be away from the neutral axis, to prevent cracking in handling. In touching up or repairing concrete where the reinforcing is exposed, the cement gun is recommended for use after the steel has been cleaned with the sand blast.

Finishing Floors

Is it better to install cement fill and finish before or after plastering is done?

What methods have been found successful in making concrete floor finish set up quickly in cold weather?

The advantages of curing monolithic floors by keeping them wet have never been realized by or brought home to building contractors as they have to road contractors. A discussion on how to get a hard, non-dusting concrete floor would be helpful.

What is your experience with the use of chemical hardeners for preventing dusting of concrete floors and to improve waterproof qualities?

In the discussion of these questions, by N. M. Loney, vice-president Thompson-Starret Co., the ordinary methods for making concrete floor finish set up quickly in cold weather were mentioned as including the use of preparations of calcium chloride, hydrated lime, hot water and heated aggregates. The use of accelerators for floor finishing was believed justified, inasmuch as they would definitely fix the time when finishers could get on the job.

The proper curing of floors is sometimes prevented by the fact that owners are not willing to give the builders the proper amount of time to finish the floors, and poorer results are obtained. The advisability of educating the owners, engineers and architects to allow proper time for curing was pointed out as a requisite for good floor surfaces.

Floor hardeners having magnesia fluo-silicate as a base were mentioned as having some merits, especially on floors not too defective. If floors are properly finished, the hardeners give good results.

Placing Concrete—Chute or Buggy?

What is the most economical method of handling concrete on a job considering quality as well as cost? This means from the time it leaves the mixer until it reaches its final destination in the building.

Why do some of the biggest and most successful contractors place their concrete from buggies rather than through chutes? What are the relative advantages of the two methods of placing?

What are the advantages of distributing concrete from the mixer through chutes, buggies and wheelbarrows? You may know that although the chute is very popular among contractors, several of the leaders who have studied the problem very carefully very seldom use them. "There is a reason."

How would you determine whether the tower and spouting system or elevator was most economical and best adapted for concreting a particular job?

In discussing the questions as to the comparative merits of buggies and chutes for placing concrete, H. C. Turner stated that better control is to be had by hoisting and delivering the concrete with buggies than by chutes. No great economy results with chuting, according to Mr. Turner's experience, except under certain conditions, such as of abnormal labor cost. The importance of water control in the concrete mix was emphasized and the fact pointed out that there was a tendency to neglect the control of the water where chutes were used for placing the concrete, with the result that the concrete was not of the proper consistency.

That on some types of building, the showing made by the chuting method may be reversed as compared with other types of equipment for placing concrete, is the experience of W. F. Lockhardt, who further stated that the time element and the size of the building in question were important factors that enter into the question. The use of chutes was to be recommended usually only on jobs involving not less than 4,000 cu. yds. of concrete. Instances were mentioned where concrete placed through chutes which tested 1,800 lbs. per sq. in. had been improved by the cutting down of the amount of water so that the resulting strength of concrete was raised to 3,300 lbs. per sq. in., and the conclusion was drawn that it was possible to place much drier concrete through chutes than is ordinarily used in connection with chuting equipment. The type of structure has considerable bearing on the method used, whether chuting equipment or buggies are employed in distribution.

The Concrete Specialist Contractor

Is the concrete specialist contractor about to become a thing of the past?

The question as to whether the concrete specialist contractor is about to become a thing of the past was answered in the negative by H. C. Turner, stating that this is a day of specialists, and that the specialist will continue in the building industry. Concrete building problems are classified as different from those with brick and steel. It is a peculiar material and special equipment and special organizations are advantageous in carrying out concrete construction.

Batch vs. Continuous Mixing

Why does the average contractor use a batch in preference to a continuous mixer?

Continuous mixers are not suitable in building construction, since there is a difficulty in controlling the mix where the process is continuous, according to J. G. Ahlers. Mechanical operations and the conditions at hand are the controlling factors to be taken into consideration. In building construction, it is necessary to hoist the concrete, as it is practically all used at a point higher than where mixed. This also favors the batch mixer.

Premixed Aggregate

Is the use of pre-mixed aggregate now on the market and in common use in some cities to be encouraged or discouraged for concrete structures of small sections, such as occur in building work? Is the use of pre-mixed aggregates economical? What are their other advantages and disadvantages?

What is the range of variation in the grading of pre-mixed aggregate at the time it enters the mixer? What is the effect of the above variations on the yield, cement factor, water-cement ratio, density and strength of the resulting concrete? Are these variations sufficient to necessitate correcting measures, and if so, what is the best method of determining and making corrections? What are the comparative costs per cubic yard of concrete made from mixed aggregate and separate aggregates?

Ready mixed aggregates should be encouraged, since their use has been found economical, particularly where they occur ready mixed in nature.

In cases mentioned by J. G. Ahlers, there was more variation in the tests taken on the dredge, where the mixed aggregate was being transported than at the time of going into the mixer. It was found that corrections could be based upon one sieve analysis, because of the continuity and uniformity of the ready mixed aggregate.

The suitability of natural mixed aggregate was evident from the fact that on 5,000 yds. the maximum variation of only 2/10 in fineness modulus was noted.

Stadiums[1]

Design, construction and cast of concrete stadiums were considered in a paper by Clyde T. Morris, Ohio State University, Columbus. The modern American games for which structures of large seating capacity are required are racing, base ball, and more recently inter-collegiate foot ball. There are three types of stadiums and the selection for a given case, depends upon local conditions and the uses to which the structure is to be put.

These three types are: the hillside type; the type built by excavating for the playing field and the lower half of the seats and banking the earth around on which to place the balance of the seats; and the third type which has the entire seating capacity supported above the ground level on structural work, and is the most expensive type to build.

Owing to governing conditions, only the third type of structure, that entirely above ground, could be built for the Ohio Stadium.

The plan decided upon consists of an open-end horse shoe with bowed sides and a double deck. The double deck is not new in base ball grandstands, but has never before been used in a college stadium. The effect is to bring about one-third of the seats 50 ft. closer to the playing field without materially increasing the height of the structure.

In plan, the stadium is about 704 ft. x 597 ft. enclosing an arena 556 ft. x 294 ft. Future development of the structure calls for closing the arch openings with factory sash and glass. The activities as planned require that the space beneath the seats be kept as free from obstruction as possible. The column spacing was made wide and the bracing kept high. These features increased the cost considerably and made the use of structural steel frame more economical than a structure entirely of reinforced concrete.

The structure was designed in radial units 60 ft. long on the outside. Twin columns were provided at each joint so that the structure is completely cut through and no sliding of one part on another is depended upon. This division into sections also proved to be advantageous in providing convenient locations for construction joints. To prevent leakage through the seat banks, the abutting sections are connected by sheet lead strips bent into U shape and filled with asphaltic joint filler.

The main entrance is featured by a half dome 70 ft. in diameter and 85 ft. high. This dome consists of ribs radiating from the crown and stayed by four horizontal ribs, thus dividing the dome into 45 spherical rectangles. These ribs support coffers which were precast and set in place after the ribs were completed. The middle of each coffer is inlaid with blue tile with a terra cotta rosette and electric light bulb in the center. The ribs were figured as half arches, the horizontal thrust at the crown being taken by a horizontal girder running from tower to tower and forming the prominade over the dome.

Seats are secured to the concrete by brass bolts set in the risers when they were poured.

Contractor's Plant

A spur track was run in from the railroad which was some 450 ft. north of the stadium and tracks were laid around the east side for delivery of materials and back clear around the U between the outside and the second row of columns. Locomotive cranes on these tracks handled the excavation and placed the concrete in the foundations. Concrete was delivered from the central mixing plant in yard buckets on industrial railway cars pulled by gasoline locomotives.

All concrete was mixed in a central mixing plant located about midway on the east side of the structure. The sand, stone and cement were elevated into bins above the charging floor and fed by gravity into a hopper as required.

The sand and stone were measured by volume and the cement, which was delivered in bulk, was weighed in a box on a platform scale under the chute.

The concrete for the seat banks was hoisted in the buckets from the industrial cars to a hopper and delivered through chutes to the desired location. These chutes had gates in the bottom every four feet and were mounted on tracks at the top and bottom so that they could be moved longitudinally as necessary. Travelers running on tracks on the upper deck, handled all forms and concrete for the rear half of the structure.

No effort was made to obliterate the form marks. In the architectural design the location and direction of all joints in the forms of exposed portions were shown, and so arranged as to give the desired effect.

The following cost figures were observed:

Excavation	$0.93.2/10	per cu. yd.
Concrete in foundations (1:2½:5)	6.92	per cu. yd.
900 concrete piles (made on the ground)	1.16	per ft.
Superstructure forms	.22	per sq. ft.
Concrete in superstructure	8.09	per cu. yd.
Reinforcing steel	50.18	per ton
Structural steel	75.40	per ton
Cast stone (in place)	2.69	per cu. ft.
Stucco and plaster	.90	per sq. yd.
Extension joints (including lead and asphalt)	.39	per sq. ft.

The total cost is approximately $22 per seat. If ornamental effects were dispensed with, this cost would be reduced to about $19 per seat.

The design and construction methods of the stadium of the New York Yankees were discussed by R. L. Bertin, engineer, White Construction Co. This structure comprises the first deck, mezzanine and roof. The main deck and all below are constructed of reinforced concrete. No expansion joints were provided in the design, expansion being taken care of by the construction joints. The maximum opening of joints observed is ¼ in. No provision was made for the protection of reinforcing steel at construction joints.

Three towers were used in placing the concrete. Troughs of wood with connecting lateral troughs distributed the concrete from the towers to the various points where pouring of concrete was going on.

The material for the concrete was deposited in piles and the mixer fed from overhead boxes. Sand was handled in wheelbarrows to the mixer and the cement in sacks.

Cost records indicate that the cost per seat for the concrete deck is less than $20.

Major factors in design and construction of the University of Pennsylvania's reinforced concrete stadium were described in a paper by H. T. Campion. The controlling factor in the general design of the structure of the new stadium of the University of Pennsylvania, located at Franklin Field, was the time limitation. Work could not be started until after the spring relays on May 4, and the entire seating capacity was required for the Army and Navy game. This fact was never lost sight of as the design progressed.

It was required that the track events should be visible from any seat in the permanent stands, and that the addition of the temporary stands should make every seat, in both the permanent and temporary stands, a good seat for visibility of the football field. The track set the limits on the field side, for the permanent stands; and the the temporary stands covered the track on the two sides and the east end of the field and banked against the gymnasium on the west.

The premanent stands, which seat 35,700, are of concrete construction and the temporary stands are wood seats on easily stored collapsible steel supports. The structure for permanent stands was built entirely of reinforced concrete, although bids were received for making the principal members of steel sections. The successful contractor, the Turner Construction Co., was able to do the work at lower price in reinforced concrete, and to guarantee an earlier time of completion.

Owing to soil conditions which were not good, an open specification for concrete piles was written, for the foundation, and the Raymond Concrete Pile Co. was the successful bidder, principally on the time element. The tops of the piles were doweled and tied together by reinforced concrete beams in each direction.

The seating deck is of reinforced concrete in step form, with frequent expansion joints and supplied with drainage gutter. Cast iron brackets or standards are bolted to the risers on the deck at about 4-ft. centers, these support cypress strips, the seats being 10 in, wide without backs and in general about 25 in. back to back.

The area covered by the permanent stands is 123,640 sq. ft., and by the temporary stands is 47,230 sq. ft. The field enclosed contains 123,730 sq. ft., making a total of 294,600 sq. ft.

Expressed in unit costs the permanent structure cost $5.919 per sq. ft., or $20.498 per seat. The temporary stands cost $4.351 per seat. An average for the total is $4.672 per sq. ft. and $15.654 per seat.

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[1] Abstracts of Papers presented at Convention of American Concrete Institute, to be published in full in copyrighted *Proceedings*, Vol. 19.

Development of Reinforced Concrete Pipe Transmission of Water Under Pressure[1]

Developments of reinforced concrete pipe for transmission of water, under pressure, were reviewed by W. G. Chace, of the Lock Joint Pipe Co. It was pointed out that some important cities now depend upon this class of construction as a link in their systems of water supply for domestic uses.

As a staple, reinforced concrete pipe is made by the wet process for sewers, culverts, caissons, etc. It has been introduced and successfully applied for several years in conveying water under moderate pressure. It is now applied to pressures of over 200 ft. and is offered for either gravity or pumping lines under all pressures ordinarily met with in municipal domestic supply systems. It can be utilized in sizes from 15 in. up, and has been made up to 108 in. in diameter. Experience has led to the gradual increase in the length of units, so that at the present time 10-ft. and 12-ft. lengths are not uncommon.

Well designed and built reinforced concrete pipe are dependable, as such pipe line is a body of dense concrete, within which is a network of steel worked at low stresses. Even under extraordinary conditions, the steel would rarely be so stressed beyond its elastic limit, and a section of pipe wall is never blown out, allowing escape of a large portion of the water. This feature is of immense advantage in insuring the hourly continuity of municipal supply.

High capacity of reinforced concrete pipe lines is the result of smooth molded surfaces produced by the use of oiled steel forms. There are no projections, obstructions, or transverse grooves, to cause eddies in the flowing stream, which would reduce the capacity of the line.

The losses of water from reinforced concrete pipe lines are relatively small where the pipe sections are built of a rich mixture of cement and selected aggregate. The total seepage loss per mile is moderate, and varies with the pressure of water and the age of the concrete. Unlike the losses from the lines of steel and cast iron, the losses occurring from concrete pipe lines are greatest at the date of the initial service and decrease as the pores of the wall become filled.

Flexible Expansion Joints

Flexible expansion joints are an absolute necessity, because of the changes of length due to changes of temperature, and the types of joints offered are such that even if the temperature contraction of several pipe sections should appear at one place, there would be no loss of water due to the partial opening of the joint.

There are two general types of expansion joints used: one, the copper joint, consisting of a beaded copper ribbon secured within the spigot rim; and the other an elastic fibre-filled lead gasket, caulked between smooth machined steel surfaces on bell and spigot specials. This type is used in two forms—the "lead and steel" joint and the "lead and iron" joint.

With the lead and iron joint, the forced entry of the spigot of one pipe into the ring gasket inside the bell of the next pipe unit caulks the gasket radially for its entire width and forces it into the wedge-shaped groove in the bell. The lead and steel joint comprises a plain band of steel of sufficient width as a bell fitting, and a special band, bearing a conical rib, as a spigot fitting. After the entry of the spigot the joint is caulked into position from within the pipe. The copper joint, and the lead and steel joint, are used within pipes whose diameters permit men to work from within.

There are no initial stresses in reinforced concrete pipe such as occur within certain metal pipes, and properly made reinforced concrete lines are strong in resistance against the pressure of the earth back-fill.

A good reinforced concrete pipe is permanent as steel within good concrete, if provided with sufficient external cover, is free from corrosion. No waterproofing, tar coating, painting or other protection is necessary, nor is there any maintenance cost.

It is moderate in first cost in the diameters in which it is offered, and can be laid without the employment of high-priced workmen. Its long life means that the yearly sinking fund charges for the retirement of the bonds covering the utility are small.

Manufacturing Processes

Two processes are used for manufacturing Lock Joint reinforced concrete pipe. One method is by pouring a wet mix concrete into oiled sheet steel molds, and the other is the centrifugal method. The "poured" pipe is manufactured in two styles—bar or mesh reinforced pipe, for the lower pressures and for the higher pressures, using similar reinforcement supplemented by a sheet steel cylinder to reduce seepage through the necessarily thin walls of the pipe.

Centrifugal concrete pipe is made in diameters from 12 in. to 36 in., without the sheet steel water stop. By the centrifugal method of manufacture, the resulting concrete weighs over 150 lbs. per cu. ft. (See Concrete, November, 1922, p. 162.)

The secret of the successful application of the reinforced concrete pipe to the conveyance of water under pressure lies in the provision of proper joints to care for the contraction of length which follows a fall in temperature of the water carried. In spite of great care in the preparation of the trench floor, and no matter how carefully the earth backfill may be placed, there frequently occurs a settlement of foundation or a movement of trench walls which would fracture a continuous pipe of concrete. The provision of flexible watertight joints between individual units of precast pipe is necessary for the protection of the line against such injury and ensures its watertightness even with deflection or movement after the laying and jointing shall have been completed.

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[1] Abstract from Paper presented at American Concrete Institute Convention, to appear in full in copyrighted *Proceedings*, Vol. 19.

Research in the Field of Concrete

Professor W. K. Hatt, chairman of Committee E-3, reviewed briefly two reports submitted by his committee in the past and stated that further research was worthy of the support of the machinery manufacturers. Bulletin No. 21 of the National Research Council was referred to as reporting research including experimental work in proportioning concrete. The greater part of the research is in non-bituminous fields.

Highway research was referred to as something more than testing materials. Roads should be built not as monuments but for transportation. The problems in highway engineering are closely related to highway economics. In referring to the prophecy of automotive engineers in regard to the production of 20,000,000 cars, it was cited that a little is known about the maintenance cost of roads but very little is known about the maintenance of the vehicles. An economic balance between the two maintenance costs is a subject for further research work.

The Editors will welcome authentic information bearing on the subjects covered in CONCRETE.

If you can add any information based upon your experience, pass it on to the readers of CONCRETE.

Laying Concrete Pipe

By Paul Kircher
Massey Concrete Products Corporation

The forces in an earth fill are always more or less indeterminate. They vary with the internal friction of the material, the percentage of moisture it contains, the method of filling, the height of the fill, etc. They vary both in magnitude and direction. To measure them is difficult. There is considerable difference of opinion among engineers as to the principles governing such forces.

Properly designed and manufactured concrete pipe has so clearly demonstrated its efficiency for culvert purposes during the last 15 years that the possibility of failure if the forces are not properly counteracted is too often overlooked. Experience is of course a reliable guide until the controversies involved in earth pressures are settled, but every encouragement should be given to experimentation and study in this field to determine conclusively the principles on which we can safely rely.

Concrete Is Strongest in Compression

In common with other concrete structures, concrete pipe is most efficient when the only strains to which it is subjected are those of compression and shear. An empty pipe, perfectly round, will have only compressive forces acting in its wall when submerged in water. Internal friction of earth does not permit as great a horizontal force to exist as the vertical one, and therefore the radial forces do not act upon the pipe as in a liquid. On account of the excessive vertical forces over the horizontal forces, the pipe is subjected to bending as well, and tensile stresses are produced in the walls.

The most severe conditions to which pipe can be subjected is when the entire force is applied at two diametrically opposite points, as is usually done when testing it. Only a small fraction of the wall can then act in compression. For this reason steel reinforcement is necessary in concrete pipe, to counteract the tensile forces, and to bring more concrete into compression.

Of course, no fill will create a knife-edged load, but somewhere between the knife-edge and the liquid pressure must lie the point that represents the actual load created by the fill. It is well to keep this fact in mind, because later we will try and see by what means we can more nearly make the loads act like those created by a liquid.

Dean Marston, of the Iowa College of Agriculture and Mechanical Arts, has given this matter much thought and is now engaged in an extensive research to actually determine what these pressures are. Engineers have believed in general that if pipe laid in a ditch was properly bedded and back-filled, an arching effect is created that sooner or later reaches the point where any additional load will not affect the stresses in the pipe.

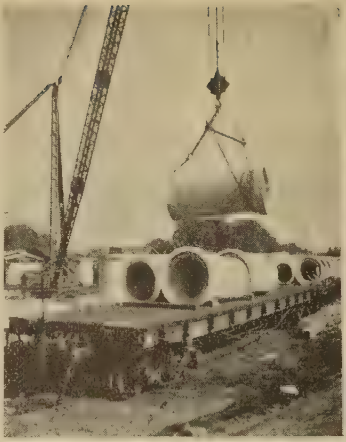

Fig. 1—(Left) Loading Smaller Diameters with Chain Sling

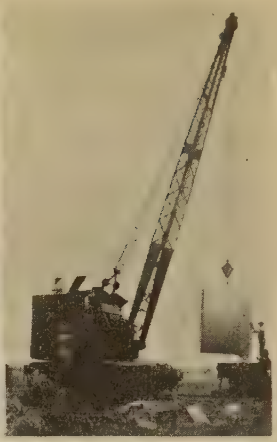

Fig. 2—(Right) Pipe Supported Through Hole at Center of Gravity

Dean Marston expresses this theory in a different way and shows that the load, through unequal settlement, may be greater or less than the actual superimposed load. In other words, the arching takes place, but the arching may be such as to carry a part of the load either on to or away from the pipe. The explanation of this is too lengthy to include here, but the basis upon which all this rests is the settlement that takes place after the fill is made. If a fill can settle more at the sides of the pipe than it does over the top, then it will drag down the earth directly over the pipe and increase the pressure. If it can settle less, it will decrease it by supporting some of the fill directly over the pipe.

The pressure exerted by your hand on a table depends on two things—the force applied by the hand and the resistance offered by the table. If the table is weak, the hand cannot press any more than the table will support. If the table is strong, it will support as much pressure as your hand can exert. Pipe that is laid upon rock will fail more quickly, therefore, than that laid on less resisting material, for if it can settle into the material, the pressure is reduced. Also, a fill that is less compact over the pipe than at the sides will not crush as easily as that where the compact is uniform, because the sides will help support the load when settlement begins, until these sides are overloaded. Such overloading may be very good, because it will produce motion in the fill. This motion will not all be down-

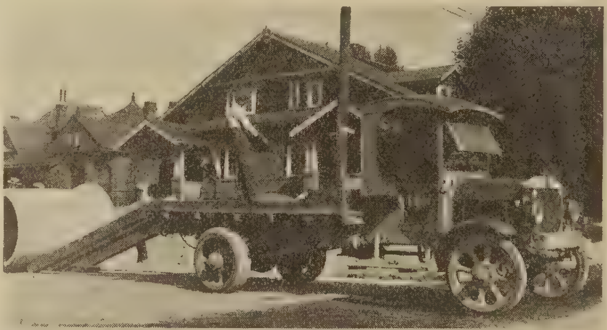

Fig. 3—The Right Way to Unload Pipe from Car, Truck or Wagon When Power Equipment Is Not Available—Heavy Skids, Ample Line—Pipe Is Not Released Until It Has Reached a Resting Place Where It Will Not Roll

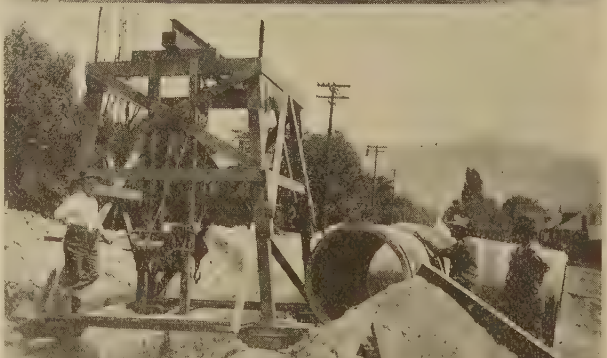

Fig. 4—Laying Salt Lake City Run-Off Storm Sewer—48-in. Pipe

FIGS. 5 AND 6—LAYING CONCRETE PIPE

ward, but sidewise as well, and will thereby create the horizontal pressure that is needed to balance the vertical one and bring the walls more nearly into uniform compression.

APPLYING THE PRINCIPLES

The conditions under which culverts are laid vary greatly and the application of the principles outlined above depends on these conditions. The worst combination of conditions would be a level rock surface with a high fill or a heavy load, such as a railroad track, directly over it. In this case the rock directly under the pipe should be blasted and a softer fill placed in the excavation, so that the pipe can settle and relieve the pressure. After the pipe is laid, the material should be carefully tamped, not only around the pipe, but to some distance either side of it. The supporting material would then be capable of producing the radial pressure which is desired to increase the amount of compressive strains in the pipe. After the fill has been carried some distance above the pipe, a trench of the width of the pipe should be dug down to the pipe and this trench loosely backfilled. This calls into play the third method of relieving pipe strains, for the compact shoulders can give the center fill a support.

But suppose the surface is a bog. A foundation must then be built to carry the load. Such a soil is so nearly a liquid that if the foundation is properly built the pipe will practically be in compression all around. Pile bents supporting at least three rows of stringers make a suitable foundation for such a condition. If one stringer is placed at the bottom of the pipe and one to either side of it, some 60° distant, one-third the surface of the pipe is taken care of. The upper half of the pipe, under such a condition, will naturally receive the pressure from the fill and therefore but one-sixth of the surface is theoretically unsupported. This one-sixth will, of course, receive some support from the fill, but can hardly be counted on to take very much. If, therefore, the fill is great and settlement is expected, some precautions in the way of strengthening the pipe should be taken, and it is well to obtain advice from those familiar with this type of construction before attempting to make such an installation.

HANDLING PIPE SAFELY AND ECONOMICALLY

The smaller sizes of concrete pipe are usually shipped lying down, either crosswise or lengthwise of the car, while the larger sizes are shipped standing on end. Where a derrick car or locomotive crane is available for unloading, the chain sling has proved its value. When made of ⅝-in. or ¾-in. chain, with a spreading bar made of an old rail, I-beam or channel, it will lift and turn pipe without danger of slipping.

Concrete pipe can be provided with a hole for lifting at the top in the center of gravity. An eye-bolt can be inserted in the hole from above, a block of wood slipped over the bolt inside the pipe and held in place by a washer and nut. The hook on the lifting block of the crane can then be inserted in this eye and the pipe swung off without further adjustment.

When power equipment is not to be had for unloading pipe from cars, trucks or wagons, a chain block and skids are needed. Particular care should be used to see that stout skids are provided, down which the pipe can be rolled. Sufficient line should be at hand to carry the pipe down slowly, and it should not be disengaged until the pipe is in a position where it will not roll. When pipe shipped standing up is tipped over preparatory to skidding off, a cushion of some sort should be provided for it to fall on.

Laying pipe on level ground requires very little lifting and frequently the tripod is the simplest and most effective means of handling. The only equipment needed in addition to the tripod is the ever-useful chain block.

In laying pipe under old fills or under trestles where head room is limited, chain blocks are very useful in lining up the sections of pipe. A dead man can be set on line with the pipe and the chain block attached to it. The K hand power puller has been used to good advantage in this connection, as it offers a means of greatly increasing the pulling power of a man with a chain block.

When pipe is to be installed in a trench, gantries save their cost even for short trenches, particularly if heavy pipe is to be handled. Hand crabs should form a part of every pipe laying gang's equipment, and for trench work they can be used advantageously on the gantry.

MISCELLANEOUS SUGGESTIONS

Before laying concrete pipe, a bed should be prepared by excavating a semi-circular trench which will conform as closely as possible to the contour of the bottom of the pipe. Transverse excavations should then be made for the bell of the pipe, so as to relieve it of excessive loading and distribute the load uniformly along the length of the pipe. When two lines of pipe are laid side by side sufficient space should be allowed between them to permit efficient tamping below the horizontal diameter.

One of the most important points to be observed in laying concrete pipe is the proper grouting of the joints with 1:2 cement mortar.

If this is not done, leakage may cause percolation through the fill or the leakage may seep under the pipe, undermining it so that it will fail in the resulting settlement.

An easy way to make sure that strains caused by early settlement of the fill will not damage culvert pipe is to provide shoring, which will transmit the pressures on the top of the pipe directly to the bottom. This shoring should consist of 8 in. x 8 in. or 10 in. x 10 in. timbers, depending on the size of the pipe. These should be cut to a length approximately equal to the length of the section of pipe, one line at the top and another at the bottom. Vertical struts of the same size are then cut 2 in. or 3 in. shorter than the distance between the stringers, and wedged in place by wooden wedges at the top.

In backfilling, no large boulders or chunks of frozen or saturated earth should be dumped on the pipe or used to fill around it. The entire fill should be soaked at intervals if possible to compact the entire mass. It is suggested that in filling from a trestle, dumping directly on the pipe should not be permitted until the fill over the pipe is at least 15% of the total fill.

All pipe should be laid true to grade and as near as possible in the direction of the channel of the stream. Massey Class B pipe is oval in shape and must be laid with the long diameter vertical. This is not difficult to insure through the inspection that is normally required. Culvert pipe should either be extended so its ends reach at least to the toe of the slope of the fill, or else a headwall should be provided to protect both inlet and outlet. Rip-rap at the outfall end is also useful, particularly when this is above normal level of the stream bed.

The above suggestions should not be considered a final guide for laying pipe under special conditions. They are principally intended to call attention to some of the features that must be considered when attempting to judge local conditions. For this reason each particular job should be given consideration and deserves careful attention. Although pipe is inexpensive in comparison with many other types of structures, it frequently takes the place of these more expensive types and therefore should have as much attention as though it were as expensive as the structure that otherwise would have to be used.

Insulation

Numerous inquiries have been received indicating considerable interest at this time in the subject of heat conductivity of various materials, the interest evidently originating in the bigger coal bills these days. More resourceful builders are going in the direction of the conservation of heat, especially in dwellings. There is interest in it, also, from the standpoint of cold storage warehouses and other similar construction. The following recently collected data are offered on this subject:

An article printed in *Chemical and Metallurgical Engineering* gave these values for the heat conductivity of the following materials. The tests on which the values are established were made by laboratories of the Verona Chemical Co., at Newark, N. J.

Material	Weight per cu. ft.	Heat Conductivity
Concrete—1 cement, 2 sand	128 lbs.	0.1760
Gypsum board	62.5	0.0846
Porete, reinforced with exp. metal	61	0.0786
Yellow pine, North Carolina	40	0.0719
Air cell, asbestos board	18	0.0335
Cork board	11.7	0.0277

A very good discussion on heat conductivities of various materials is given on page 1085 of Hool and Johnson's *Handbook of Building Construction.* The information contained in this discussion was established by a series of tests carried out by the Research Laboratories of the University of Illinois by A. C. Williard and L. C. Lichty, and published in Bulletin No. 102, University of Illinois, entitled *A Study of Heat Transmission of Building Materials.* The following values give an idea of the relative heat conductivity and insulating qualities of various materials:

Material	Relative Heat Conductivities
Dry brick wall	4.0
Brick wall with moisture	5.0
Sandstone	9.0
Concrete, 1:2:4 mix	8.3
Plaster, or mortar	8.0
Wood (fir), one surface finished	1.0
Cork board	0.32
Magnesia board	0.50
Asbestos board	0.50
Sheet asbestos	0.3
Packed mineral wool	0.35
Glass—single (91.4%, total area)	2.06
Glass—double (½ in. air space, 69.3% area)	1.5
Roofing—2 in. tile*	5.3
2-in. tile roofing, plastered*	0.84
2-in. tile, ½ in. plaster, both sides*	1.00
4-in. tile, ½ in. plaster, both sides*	0.60
6-in. tile, ½ in. plaster, both sides*	0.47

*For thickness stated, not for 1 in.

Concrete Walls and Floors, Stucco and Brick Facing, Built by Hueber Brothers, Syracuse, N. Y.

Fireproof Homes in Syracuse

Methods of Estimating Cost of Concrete Work[1]

By Frank R. Walker

It is impossible to prepare an estimate on concrete work without first having a method of measurement and after the quantities have been prepared, it is necessary to have unit costs compiled in the same manner in which the quantities have been listed, if we expect to have a semblance of accuracy in our estimates.

It seems that each contractor has developed his own method of estimating or has followed the path of least resistance that has enabled him to "get by" but with no valid reason for using that method, except perhaps, that it was quick—but the same could not be said of its accuracy.

If estimates are to be accurate, so that the contractor will feel safe in taking work on his own figures, the various branches of work should be estimated in exactly the same manner in which it is erected in place in the structure, using each completed operation as the basis of measurement and pricing the work. Regardless of the method used in preparing the estimate, if the contractor's field organization is incompetent or inefficient the best prepared estimate will not make the contractors' business a profitable one.

Each class of concrete work should be estimated separately, such as footings and foundation walls, column footings, retaining walls, reinforced concrete columns, beams and girders, stairs, structural floor slabs, etc., because each is a separate and distinct class of work, involving special details of construction not found in the others, and subject to considerable variation in the cost of the completed units.

Foundations and Retaining Walls

When estimating the cost of concrete for foundations and retaining walls, the cost of the wood or metal forms, reinforcing steel, and the cost of the concrete itself, should each be estimated separately as they are all separate kinds of work and in many instances installed by different trades.

The concrete itself should be estimated by the cubic foot or cubic yard. The cubic yard method is preferred because the costs are more easily worked out on that basis. Nearly all tables of cement, sand, gravel or crushed stone are stated in the quantities required per cubic yard of concrete, which makes a more workable unit than where the cubic foot method is used.

Form work should always be estimated by the number of square feet of forms required for any given piece of work; for instance, if a wall is 60 ft. long and 8 ft. high and requires forms on both sides of the wall, it will require 960 sq. ft. of forms. Light walls will require only 2 or 2½ ft. of lumber, b.m., to construct 1 sq. ft. of forms complete, while heavy retaining walls will require 3½ to 4 ft. of lumber, b.m., per square foot of forms. Naturally the more lumber required per square foot of forms, the higher the material and labor costs will be.

It is not a difficult matter to strike an average of the amount of lumber required to construct one square foot of forms for various types of walls, and by so doing valuable costs both by the square foot of forms and per thousand feet of lumber, b.m., are furnished. This is especially valuable when comparing costs on various jobs. The cost of removing the forms should also be kept separate from the cost of framing and erecting, but the same units of measurement should be used throughout.

Reinforcing steel should be estimated by the pound or ton, estimating the cost of steel at a certain price. The labor bending the steel should be kept separate from the cost of placing the steel in the structure ready to receive concrete.

When estimating the quantities and costs of reinforced concrete superstructures, each class of work should be estimated separately as previously described for foundations and retaining walls, but the average concrete building contains at least four different classes of reinforced work, namely: columns, beams and girders, floors and stairs.

Columns

The forms for square concrete columns should be estimated by the square foot, taking the entire girth of the column and multiplying by the height. As an example, take a column 17 in. square and 12 ft. high. Forms will be required on all four sides of the column, making a total girth of 72 in. or 6 ft, which multiplied by the height, will give 72 sq. ft. of forms required for each column. Where 2-in. lumber is used, it ordinarily requires about 2½ ft. of lumber, b.m., to construct 1 sq. ft. of forms, including bracing, clamps, etc. In order to prepare accurate estimates on the cost of this work, it is advisable to estimate the cost of framing and erecting the column forms, separate from the labor cost of removing them after the concrete has been placed. The same units of measurement should be used in both instances.

The forming for octagonal concrete columns presents a somewhat different problem in estimating. Regardless of the diameter of the column, there are eight different sections to be formed, and it does not cost any more to frame an 8-in. section than a 6-in. one, so it is a question whether it is not advisable to estimate the labor cost at a certain price per column, making a slight allowance for the difference in size. However, regardless of the diameter of the column, the labor cost of framing and erecting the forms in place should be kept separate from the labor cost of removing the forms after the concrete has been placed.

Metal molds are ordinarily used for forming round concrete columns. The column molds are fabricated in the shop and delivered to the job in sections, so that a certain price should be allowed for the erection and removal of each column mold, stating the diameter and height of the column, and whether a plain shaft or one having a flared head, as the latter cost considerably more to erect than the former. (The cost of the erection of the forms should be kept separate from the removal of them if possible.)

The column reinforcing steel should be estimated by the pound or ton. Inasmuch as the spirals are usually furnished fabricated and the steel cut to length, the labor estimate should include assembling, wiring and placing, based on the actual weight of the steel used.

The concrete in the columns should be estimated by the cubic foot or cubic yard; the materials being estimated according to the proportions of cement, sand and gravel used, and the labor costs of mixing and placing should be estimated separately.

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[1] Abstracted from a paper read at the convention of the American Concrete Institute, Cincinnati, O., January, 1923.

Beams and Girders

There is a diversity of opinion among contractors regarding the correct method of estimating forms for concrete beams, girders, and lintels. When used in connection with concrete floor slabs, the depth of the beam or girder ordinarily includes the thickness or depth of the slab, so when estimating the quantities and cost of beam and girder forms, I feel the proper method is to take that portion of the beam or girder that is exposed beneath the slab, while some contractors estimate forms for the full depth of the beam. For instance, if a concrete beam 16 x 24 in. in size, the thickness of the slab 6 in., the actual depth of that portion of the beam requiring forms is 18 in., the other 6 in. being made up in the thickness of the concrete floor slab. Where beams and girders are used around stair well openings, elevator shafts, door and window lintels, etc., where one side of the beam is exposed for the full depth, then the girth of the beam would be 18 in. plus 16 in. plus 24 in. or a total of 58 in.

Beams may be constructed of either 1- or 2-in. lumber or a combination of the two, but the labor cost per square foot remains practically the same in either instance. The 1-in. lumber is somewhat easier to frame but it requires more bracing than the 2-in. lumber; so that the advantages of one practically offset the other. While the estimated labor costs should be by the square foot of forms actually constructed, the labor cost of framing and erecting the forms should be kept separate from the labor cost of removing the forms after the concrete has been placed.

The reinforcing steel should be estimated by the pound or ton, based on the actual amount of steel required. Bending and fabricating should be kept separate from the labor cost of placing the steel in the forms ready to receive the concrete.

There are so many types of reinforced concrete floors being used today that it is almost necessary to use a different method when estimating each type. It is true, the square foot method of measuring the forms can be used in all of them, but there are so many special conditions entering into the construction of the forms for the various types of floors, that each must be given careful consideration when preparing the estimate. The amount of lumber required to construct 1 sq. ft. of forms for reinforced concrete floors will vary from about 2¼ to 4½ ft. b.m., which includes sheathing, joists, stringers, uprights, sills, wedges, bracing, etc. This variation is due to the thickness of the concrete floor and the height of the ceiling. For this reason, it is well to check the square foot method with the price per thousand feet of lumber, b.m., before pricing the estimate.

Floor Slabs

It is not necessary to figure out the exact quantity of lumber required in the construction of the slab forms for each job estimated, but a table can be easily prepared showing the approximate amount of lumber required to construct 1 sq. ft. of forms for different slab thicknesses and varying ceiling heights. This will be close enough for estimating purposes, because I have never yet seen the job where the quantity of lumber used was the same as the quantity estimated.

Before deciding upon the material cost per sq. ft. of forms, it is advisable to take into consideration the number of times each floor of forms may be used in the construction of the job. For instance, if it requires 3 ft. of lumber, b.m., to construct 1 sq. ft. of forms, with lumber at 5c per ft., b.m., the lumber cost of 1 sq. ft. of forms would be 15c. If the lumber may be used two or three times in the construction of the job, this cost may be divided by 2 or 3 to obtain the lumber cost per sq. ft. of forms. To this cost a small allowance should be added for breakage, waste, nails, etc.

Where solid concrete floors are used in connection with beams and girders (either of reinforced concrete or structural steel, fireproofed with concrete), the exact floor area between beams and girders should be obtained, and should not include the width of the beams and girders, as these forms have previously been taken care of under beams and girders, and all duplication of quantities should be avoided, if accurate estimates are to be obtained.

The same method should be used when estimating floors of flat slab construction except that the area of the depressions at the column heads should be taken off separately, as there is considerable extra labor involved in framing out for these depressions. The entire area of the floor may be estimated at a certain price per sq. ft, and then an additional allowance may be made to take care of the additional labor required for framing of depressions in slabs.

Other types of floor construction, where concrete is used in conjunction with clay or gypsum tile, metal tile, "domes" or tin pans as they are commonly called, usually require the lightest type of temporary framing for forms on account of the small weight of the floor slab itself. In all instances the exact floor area should be obtained and the work priced by the sq. ft. of forms. On work of this kind, some contractors cover the entire floor with wood sheathing while others place only a 2-in. x 6-in. or 2-in. x 8-in. plank, 12, 16 or 20 in. on centers, to support the ends of the tile or domes and form the bottom or soffit for the concrete joist which is to be placed.

It is certainly advisable to keep separate costs on the various types of floor construction both by the sq. ft. of forms and by the thousand feet of lumber, b. m., as this helps materially in preparing more accurate estimates, permitting a comparison of costs by both methods.

The actual concrete on all of the various types of floors should be estimated by the cu. ft. or cu. yd. but there is a vast difference in the labor cost of placing concrete on a job having 10- or 12-in. floor slabs than those using clay tile or metal domes, having concrete joists 4 or 5 in. wide with only 2 or 2½ in. of concrete placed over the top of the tile themselves. The former will require 4 or 5 times as much concrete per sq. ft. of floor as the latter.

On heavy slabs it is possible to place a large amount of concrete in a comparatively small floor area, while with the combination types of floor, it is necessary to cover a large floor area and place a comparatively small amount of concrete. Floors of this type require considerable extra labor placing the concrete in small joists, using care to see that all reinforcing steel is covered, as well as extra labor in spreading and grading the concrete for the thin top slab. While the cubic foot or cubic yard method of measurement may be used for either type floor, the labor cost on one will be much higher than on the other.

Cement Floor Finish

Where the floors are to have cement finish top, the top should be estimated separately in all instances. The thickness of the top may vary from ½ in. to ¾ in. in thickness and is composed of cement and sand, an entirely different aggregate than the mass concrete. This will involve separate material and labor costs, such as cement finishers and helpers, placing screeding and troweling the top, which is in addition to the labor required placing the structural concrete. Measurement of work of this kind should be by the sq. ft.

CONCRETE STAIRS

Nearly every contractor has his own method of estimating concrete stairs. Many take the underneath surface or soffit of the stairs to obtain the forms required, while others take the area of the soffit plus the number of lineal feet of risers. It is a difficult proposition and one that is not easily checked.

I have used the following method of estimating concrete stairs for a number of years and it has worked out very well:

I first take the length of the stringers of each flight of stairs, making a note of the number of treads in each. According to my experience on the job, the most time is required in laying out the stairs, cutting the stringers and placing them ready to receive the sheathing and risers. I usually allow a certain number of hours carpenter time to lay out, cut and erect the stringers. I then estimate the sheathing in the same manner as is used in estimating slab forms, making my allowance in the price. I then mention the number of treads and the length of them, together with the number and length of the risers to be placed. In making up my estimate in this manner, I have found my estimated and actual costs compared very favorably.

The concrete is estimated in the usual manner to obtain the number of cubic feet or yards of concrete to place.

If the stairs are to have a cement finish, I usually allow 18 in. to take care of the width of each tread and riser and multiply this by the length of the treads and the number of treads to obtain the number of square feet of finish.

When estimating the quantities of mesh or fabric reinforcing, I think the actual area of the surface to be covered should be obtained and then a certain allowance made to take care of the laps, the same as is used when figuring wood sheathing or flooring.

PLANT EQUIPMENT

In my opinion, the item of plant and equipment should be estimated separately, allowing a certain price for concrete mixers, hoisting engines, hoisting towers, and other equipment, as in many instances this cost would be the same whether the job contained 1,000 or 5,000 cu. yd. of concrete, so that if this is estimated separately, it is much easier to obtain costs from the work that are authentic and of value when preparing future estimating.

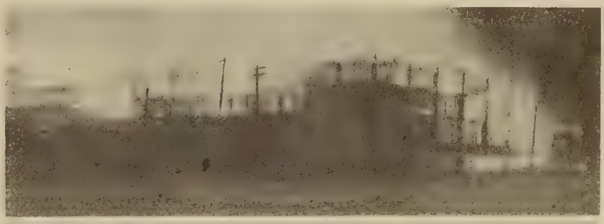
If the estimated quantities on all classes of work are as possible to the actual quantities that are to be placed in the job and if costs are kept in the same manner, the contractor should be able to compile costs that will prove invaluable to him when preparing estimates on future work.

Severe Form Work Fire Tests Winter Concrete on Warehouse Job[1]

BY ARTHUR R. LORD
PRESIDENT, TAIT AND LORD, CIVIL ENGINEERS, CHICAGO

Within the memory of the youngest of us the construction of concrete buildings halted at the approach of winter. October or November rang down the curtain and left the stage empty until the following April, with all the attendant evils of skilled men out of work and feverish haste in a short working season. Theoretically, winter work, if it be admitted that with proper precautions concreting may be safely carried on in winter, must cost more than summer work. Actually, the cost is very little greater. While it is inescapable that heating and enclosing the work costs extra money and also that cold weather makes working conditions more difficult, on the other hand concrete materials are cheaper in winter and workmen are eager to hold their jobs as compared with warm-weather inefficiency. As the years have passed concrete operations of greater and greater magnitude have been continued into the winter or even started in winter. One important trouble with concrete work of great dimensions, that of contraction cracks, is undoubtedly minimized by cold-weather work. The fire described in this paper constitutes one of the most thorough tests of winter concreting which has come under the writers notice.

Winter concreting operations are still regarded as hazardous by many prominent engineers. Specifications quite commonly require all work to cease when the temperature falls to 20° F. or 15° F. above zero. The work on the McDougall terminal was carried forward regardless of temperature, with precautions deemed suitable to the conditions at any particular



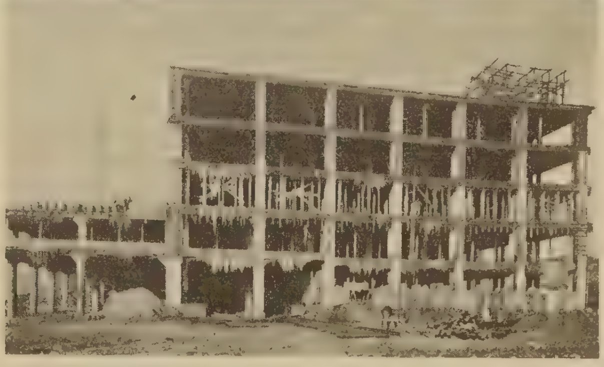


FIG. 1—WAREHOUSE FIRE ABOUT 30 MINUTES AFTER THE FIRST BLAZE WAS DISCOVERED.

FIG. 2—APPEARANCE OF WAREHOUSE AFTER THE FIRE.

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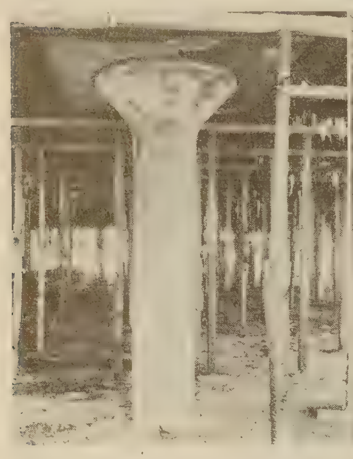
[1] Abstracted from a paper before the American Concrete Institute, Cincinnati, O., January, 1923.

time. The only real occasion for postponing work, in the opinion of Jacobson Bros., contractors for this terminal, is a good snow storm which makes the job "blind". Necessity breeds enterprise in such matters, for Duluth would have an unduly short building season with all the weather below 15° left out. Accordingly the construction of this building went on with temperatures at time of depositing concrete all the way from 20° above to 20° below zero. A very high rate of progress was also maintained. In one part of the building four floor levels were placed within two and a half weeks, the last being placed on the morning of the fire. In general no loss in time was involved in this building as compared with summer work. In a building constructed under these severe conditions and where the greatest precautions as to removal of forms would be in order, comes a fire which substantially consumed 200,000 sq. ft. of form work! The only concrete to fall was that poured the same day.



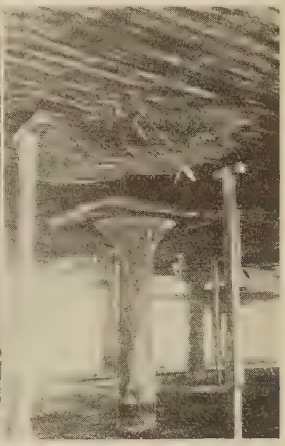


Fig. 3 (Left)—A Completed Column Showing Effect of Spalling.

Fig. 4 (Right)—Relatively Badly-Spalled Spot in Ceiling.

The McDougall terminal is a large reinforced concrete and steel structure with brick curtain walls, now under construction on the lake front at Duluth and is designed to facilitate the shipping of perishable and other commodities to the East via the all-water route. It is an undertaking in which a great number of Duluth citizens are financially interested and one of the striking facts about the fire was the evident public sympathy and the absence of any adverse criticism.

The terminal is a six story structure, 128 ft. wide above the third floor and 172 ft. wide below, extending some 490 ft. into the lake at present, with provisions for future extension. Work was being pushed as rapidly as possible. The structural steel work spanning the wagon docks and the railroad tracks in the first story was completed but not fireproofed. The reinforced concrete flat slab floors and roof would have been completed by January 15th. At the time of the fire all of the fifth floor was poured and some 108 ft. of the sixth floor at the South (Lake Superior) end. Form work and reinforcing steel were in place for another large section of the sixth floor and form work for 108 ft. of roof.

Some 400 workmen are employed. On Thursday, January 4, 1923, they quit work as usual at five o'clock. At about 5:15 p. m. one of the night watchmen approaching the building saw a small flare in the fourth story and ran to the office. The superintendent and a foreman hurriedly left the office and proceeded to the fourth story to extinguish the blaze. When they reached the floor the blaze was still confined to a single small area some 150 ft. from the ladder. However, before they could reach it, the blaze suddenly spread with incredible rapidity and the two men were overtaken by and had to pass through the fire to reach the ladder and safety. When they reached the ground and turned in an alarm at 5:20, the entire fourth story was a sheet of flame. Fig. 1, a snapshot, shows the fire at about 5:45 p. m.

The fourth and fifth stories of the building were enclosed in canvas and heated by salamanders. These salamanders had been charged with anthracite coal for the night just a short time previous to the discovery of the fire. An explanation offered for the rapid spread of the fire is that the upper part of the fourth story was heavily charged with gas from the salamanders and spread the flames throughout the length of the building.

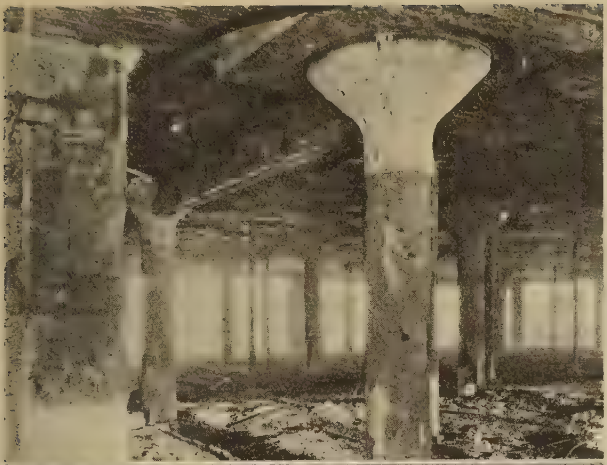
The fire apparatus responded promptly but was delayed by the removal of railway cars from the tracks in and beside the building, and the hose lines were very long. The form work in the sixth, fifth and fourth stories burned practically without check and was substantially consumed. Fig. 2 shows a view of the entire building after the fire. In general, the column and drop forms had been removed and the surface of these members received the full heat of the fire. Fig. 4 shows a relatively badly-spalled spot in the ceiling in this area. The shores shown in this picture were placed after the fire. Figs. 5 and 6 are general views and show the relatively greater damage suffered by the columns and drops exposed throughout the fire as compared with the damage to the slab protected for a while by the inch decking. The view in Fig. 6 shows clearly the joints between boards. Even the locations of joists under the decking may be seen from the marking of the ceiling.

Many of the posts fell, some of the joists either fell or were supported precariously on one or two charred posts. This form work offered little by way of support to the slab.

Some of the form work, by reason of "freaks" in the fire or wind, came through in unexpectedly good shape. A strip of roof forms along the east edge at the south end and about 15 ft. wide was almost intact although the balance of this form work was completely consumed and little if any water reached it. Some runways two stories high for pouring the roof also escaped with minor damage. The 140-ft. high tower was protected successfully by the fire department, as was also the mixing and distributing plant.

The fire, starting in the fourth story and involving that entire story within a few minutes, spread rapidly to the fifth and sixth stories above. Form work was in place for the sixth floor at the north end and the reinforcing steel was practically ready for the concrete. All this form work was completely consumed and the steel dropped and tangled. The steel also underwent an annealing process losing much of the stiffness of hard grade material, so it could be bent as easily as structural grade. The spirals and column verticals were largely protected by the metal forms but the light wire spirals of this story were so badly twisted and deformed as to be almost useless. At the south end the sixth floor had been placed five days before and its supports were entirely consumed as was the form work for the roof except for the "freak" noted above. The slab came through this severe test with little more than surface damage.

The fire also dropped from the fourth to the first story but in the first and second stories and to a less extent in the third story it was checked by the fire department. Most of the form work in the first



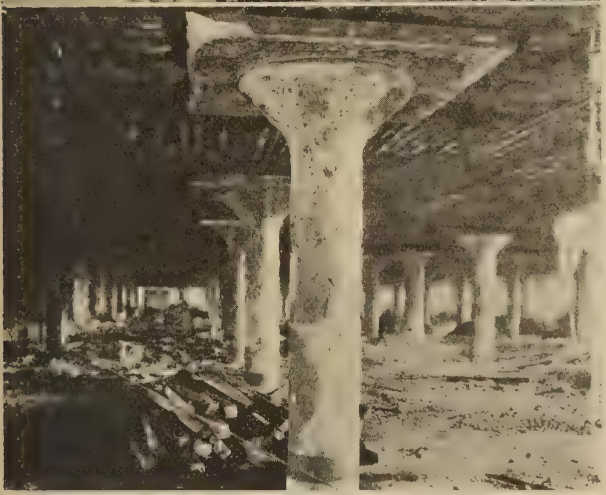


Fig. 5—Effect of Fire on Unprotected Columns.

Fig. 6—View Showing Marking Due to Fire at Joints Between Boards in the Decking Under the Slab.

and second stories had been removed and used above. In the northwest corner, however, it was in place in all stories. Here some structural steel was in place and not yet fireproofed and it was most fortunate that it had water in time to save it. The very small damage to the surface of the surrounding concrete shows that the fire made little heat here although it burned for some time.

A fire which shows what happens to unprotected structural steel in even a short fire, occurred the same week in Chicago and after twenty minutes collapse occurred, even though the truss members were composed of good sized angles. Workmen engaged in repairing airplanes were content to escape without either tools or street clothes.

Granite Pebbles Cause Principal Damage

The principal damage to the McDougall terminal was due to the presence in the aggregate of large quantities of granite pebbles which "pop" when subjected to sudden intense change in temperature. Everywhere that spalling occurred the surface presents heat-fractured pebbles. Where the form work was entirely consumed the surface of columns and drops, which were exposed for the entire length of the fire, is composed largely of such fractured pebbles. The quartz present in these pebbles was so finely divided as to be scarcely recognizable and the presence of iron further disguised the material. It is doubtful if the average engineer would have classified much of this material as granite although certain pebbles are readily identified. Where the form work was in place, the fire ate its way to the concrete at the cracks between boards or directly over the joists where the extra material made a hotter fire and in such places incipient spalling, commonly very shallow, is general as shown in Fig. 6. In a fire of this limited duration the square columns stood up as well as the round; in both shapes the damage was a surface damage almost entirely. This showing may have been due also to the fact that the square columns were at the exterior walls of the building where the fire was undoubtedly somewhat less intense. The deepest spalling uncovered some of the slab reinforcing steel, principally in the direct bands which were from one-half to one inch above the forms. The amount of spalling indicates that temperatures considerably in excess of 1070° F. (at which quartz pops) existed over large areas in this fire.

As mentioned previously some panels poured the same day fell when the forms were removed and some actually stood up. Out of sixteen panels placed that morning twelve fell. All the columns remained standing except two and all the exterior columns were inclined slightly inward and have been removed and replaced. The flat slab of the fourth floor directly below came through without injury while two rather deep spandrel beams broke under the impact and have been torn out and replaced. This floor was five days old. Some fourth story columns on the west face were cracked by the early removal of the slab forms by the fire and will be replaced with new ones. Careful examination failed to show any cracks in the slabs in any part of the building outside the small area that was poured that day.

Construction Methods

In view of the excellent behavior of this concrete structure under fire test it may be of interest to describe briefly the manner in which concreting was carried on at this job with a temperature ranging to 20° below zero F. The precautions were less, rather than more, than commonly required. Most specifications require the story above the slab just placed as well as the story below to be enclosed, but in this case the story above had no canvas protection or salamanders. The materials, both sand and gravel, were heated by means of steam jets in the piles and also in the bins over the mixer, keeping them free from snow and ice and raising them to a temperature of 70° F. finally. Concrete was spouted to a hopper and carted to its final position in the forms. It was quite wet. The story below was enclosed in canvas and the salamanders fired a couple of hours before concreting began. The top surface of the freshly deposited concrete was not protected and presumably froze, but as soon as men could walk on it a layer of sawdust and shaving some 4 in. thick was spread over it. In a half hour or less the slab was warmed through again and the top became decidedly warm to the hand. The floor finish was not placed with the slab but will be placed after the building is fully enclosed and heated. While this method departs from usual practise in several respects the "acid test" of fire seems to have demonstrated its effectiveness under extreme conditions. Workmen removing the concrete which fell and that had been heated only for a part of one day, found it very hard to break with bull-points and sledges.

Conclusions

The fire teaches us some lessons that may be valuable in our education as engineers. In Duluth all available aggregates for concrete work contain large amounts of stone which spall or pop under sudden heat or when suddenly cooled as by a stream of water in a fire. Other cities frequently present a choice and this choice is frequently ignored. A slightly greater price for non-spalling aggregate would seem to be good insurance. This has long been recognized as a result of extensive laboratory tests and experience in other fires—but we forget.

This fire shows also that concreting can be successfully carried on in extremely low temperature without loss of speed or undue increase in cost. At least 200,000 sq. ft. of this structure received a searching fire test which would surely have brought down any frozen concrete in its path.

Even with concrete made from decidedly fire-spalling aggregate the loss of value and time in a severe fire is exceedingly small as compared with that which results from a similar fire in a non-fireproofed steel framed building. The total delay in this construction will hardly exceed two weeks. It should not be overlooked, however, that winter concreting as now carried on does involve a largely increased fire risk which must be fully covered by insurance.

The superintendence and inspection work on this terminal was carried out under the direction of the architect S. Scott Joy, of Chicago. The structural design was made by the writer's firm in accordance with the Duluth and Chicago building codes.

How Much Time is Lost in Delays in Highway Construction?[1]

By H. K. Davis
Chief Inspector, Iowa Highway Commission, Ames, Iowa

In the State of Iowa in the last two years some studies have been undertaken to determine what is average production on the standard types of construction equipment on highway work. On excavation and embankment work in that state, the wheeler and slip-scraper are practically obsolete and no longer appear on the job except for very special purposes such as sand cuts or constricted spaces. The same is true of the fresno except for borrow pits or side hill location. Steam shovelers are seldom used except in connection with rock work, and in Iowa this is a small percentage of the whole. The result has been to limit the investigation of average output to the elevating grader so far as dirt work goes.

On pavement construction, the mileage of all types other than concrete has been so small during these two years that figures made on these jobs would be of very little value for purposes of comparison. The studies on paving, therefore, were confined to concrete.

On the earthwork studies, while some valuable data were collected on averages, not enough information was at hand to enable us to account for all lost time. It is, therefore, with the lost time on concrete pavement construction that this paper will deal.

The figures here submitted deal with 151 miles of concrete placed in 1921 and 101 miles laid in 1922, not a large program in either year. The merit of the data, therefore, lies not in its mass but in the fact that it was complete and covered average conditions over the area studied, also that it covers *all* the work done during the two years and not a few particular jobs which might be selected to verify a pre-conceived theory.

Working Conditions

In 1921 the season so far as working conditions were concerned was about what could usually be expected:—

1. Weather conditions were about what can usually be expected. The spring opened early and work started, but much time was lost immediately by late snows and rains. Mid-summer weather was good but one extended spell of rain in the fall lost some three weeks of time for all contractors then at work. Winter held off a little later than usual.
2. The labor supply was good and dependable.
3. Shipping facilities were more nearly normal than at any time since pre-war days, and caused no delays that are of record.
4. A supply of material adequate to the needs either existed or was developed for the occasion. On only one or two jobs were they delayed for lack of materials to an extent that was noticeable.
5. The work was well distributed over the entire State. Therefore, conclusions drawn from these figures are not limited to a small area where conditions might be very special.
6. The work was well distributed as to size of jobs. No one contractor secured any large block of work in any one location.

In 1921 the work was carried on
    On 31 contracts
    By 19 contractors
    Using 29 outfits
    On 35 separate sections of road
    In 17 different counties.

In 1922 the work was carried on
    On 20 contracts
    By 13 contractors
    Using 19 outfits
    On 24 separate sections of road
    In 10 different counties.

The term "outfit" is here used to include all loading, mixing and hauling equipment and their crews which were operated as a single construction unit.

In 1922 the working conditions could hardly be called average in certain respects:—

The weather was a little better than is usual in Iowa. There were no long rainy spells. In addition, winter held off for nearly a month longer than can be depended on as a rule, thus enabling several contractors to finish their work when otherwise they would have had to shut down.

In all other respects the conditions were as favorable as in 1921, except as regards railway facilities. Because of the coal and shopmen's strikes many outfits were laid up for long periods waiting for delivery of materials which were plentiful at the producing plants.

In all respects except these latter two, the conditions under which these two years' work was done are considered about average for the Middle West, and there may be a lingering suspicion in the minds of some of us that a state of business stagnation caused by labor strikes is coming to be more nearly the normal than the abnormal condition.

Sources of Information

The figures here summarized were compiled from daily inspection reports sent to the general office of the Highway Commission by the inspectors on the jobs for each day that the job was under way, regardless of whether any work was done. These reports give the information usually contained in such reports as to feet run per day, cubic yards, cement content, etc., but in addition show the amount of lost time and the reason for such delay, from the start to the finish of every job. The information contained in these reports was tabulated by heading a column for each construction outfit with a brief description of the work and the equipment, and following down the column with the feet laid for each day, entering on the same line the reason for any delay that occurred on that day. The runs for a given date show opposite to each other on the same line for the entire state. Delays of less than about 45 minutes are disregarded, being considered as a part of the day's work and too small to influence materially the day's run. The runs are given in linear feet since in the great majority of cases the pavement is 18 ft. wide and of a uniform depth of 8 in. A very simple conversion factor is furnished by the fact that one linear foot of 18-ft. pavement represents 2 sq. yd. of surface.

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[1] From a paper presented at January convention, American Road Builders' Association.

Incidentally, it may be stated that this method of tabulation has the merit of permitting rapid comparison between all the outfits concerned for any given day or period of time. A state-wide rain shows up plainly on the progress made throughout the entire state on that date. Also it shows up in a rather startling manner the power of recovery of the various outfits after such a rain. Those organizations that are well known for their pep almost invariably stage a quicker comeback than the easy-going ones. When two outfits work side by side and conditions are similar and the weather the same, and one outfit fails to work more than about half the time while the other produces steady results day after day, the natural conclusion is that the difference lies in the kind of management brought to the work by the contractor.

Another point frequently claimed but not as yet proved by the Iowa data is that an industrial railway haulage outfit can be run more days in the season than a truck-haul outfit when the two are operated under the same or equally good management.

Length of Construction Season

In 1921 the first concrete laid was on April 8 the last on November 16. This covers an interval of 223 calendar days, which has been taken as the length of the construction season for the most venturesome contractor.

In 1922 the first concrete was laid on April 27, the last on November 29. This made a construction season for 1922 of 217 calendar days.

Both of these seasons are considered to have extended a little later into the fall than can regularly be counted on, though only the 1922 season included a greater number of suitable work days than the average.

In the construction season of 1921 the 29 outfits laid on an average of 27,525 lin. ft. of the pavement each or about 5.25 miles. In 1922 the 19 outfits averaged 28,021 ft. each or 5.30 miles.

In fairness to the contractors on the work it must be stated that this average output for a long season's work is not representative of their producing capacity. This is clearly shown by the fact that several outfits have turned out from 10 to 15 miles in a single season. It is explained by the fact that under existing highway laws Iowa is frequently compelled by the financial situation of the counties to let pavement contracts in units smaller than what would constitute an economical length of run for an outfit for the season.

Average Performances

The average length of season per outfit required by the contractors in 1921 to complete their undertakings was 114.3 calendar days, indicating a reduction of nearly 50% from the possible total of 223. As intimated, this reduction is chargeable to the conditions under which the work was let rather than to any unwillingness or inability on the part of the contractors to carry on for a full construction season. In 1922 the average duration of time on the work was 100.8 calendar days or considerably more than a 50% reduction from the possible 217 calendar days. In any case where a contractor was able to finish his season's work within the construction season, it is difficult to see how he can in fairness be charged with the failure to work through an entire season. The findings are reversed when, because of lack of foresight or good management, he fails to make use of all the available time in starting his work in the spring or in running late in the fall and as a result fails to finish.

In 1921 the average output per outfit per calendar day was 241 lin. ft. This shows how small a figure should be used in case it is ever desirable to use calendar days as a basis for figuring. In 1922, however, the average per calendar day was raised to 278 lin. ft.

When Sundays and legal holidays are eliminated from the total calendar days in the season, a more logical basis for comparison results. In 1921 with the Sundays and holidays eliminated there remained 96.1 possible working days on the average. The resulting run figured on this basis was 286 lin. ft. In 1922 the possible working days averaged 85.7 and the run per day 327.6 lin. ft. These runs reduce to about 600 sq. yd. per possible working day as an average for the two years.

Eliminating all rainy days and other stops of an entire day leaves 74.1 days per outfit on which concrete was actually laid during the season of 1921. By the same process the days actually worked during 1922 reduces to 61.2, and not all these days were full days since many of them show only short runs when rain, breakdowns, etc., stopped the work for the remainder of the day. It came as a distinct surprise to most engineers and contractors in Iowa to find that all the concrete pavement laid in 1921 could have been placed in 2.5 months of straight time, and the entire 1922 program in 2 months, if only the numerous delays could have been eliminated. Yet the work occupied the time of all the contractors and all the engineers for most of the year.

The average road laid per day worked also seems like a very conservative figure. In 1921 it was 371.5 lin. ft. In 1922 it rose to 457. This increase is very probably accounted for in part by better management and increased efficiency. But another factor is present which is known to be responsible for the major part of it. This is the increase on the average size of the plant equipment. During 1921 the largest outfit on the work was equipped with a 21-E paving mixer or a plant mixer of equivalent capacity, while there were several smaller than this. In 1922, there was only one mixer smaller than a 21-E and several large outfits came onto the work with mixers as large as a 2-cu. yd. capacity.

The figures here obtained, if conclusive, indicate that 800 sq. yd. of 8-in. concrete is a safe estimate of the daily capacity of a paving outfit on the average, unless the size of mixers is increased, efficiency raised materially, or some method is found of beating the weather.

The 74.1 average of days on which work was done represents 64.8% of the 114.1 average calendar days in the season of 1921. In 1922 the 61.2 average days worked is 60.7% of the 100.8 average calendar days. The writer recalls having asked one contractor's superintendent what in his judgment was the percentage of time a man might safely count on as available in a construction season. After some thought he gave it as his opinion that 80% was the most that anyone could rely on. To verify his statement his outfit in 1921 came within 1.8% of reaching the 80% he had himself set as a mark. The nearest competitors his firm has had on the Iowa work in two years have not yet passed 74% in days worked out of days spent on the job. Very few have passed 70% and many are around 50.

CLASSIFICATION OF MAJOR DELAYS

The days not worked were classified under various heads according to the causes for such delay. The percent of the total calendar days thus lost was as follows:—

	Percent 1921	Percent 1922
Lost on account of Sundays and holidays	14.20	13.67
Lost on account of snow, rain, mud & frost	14.70	9.72
Lost on account of breakdown of equipment	1.09	.47
Lost on account of shortage of material	1.14	9.83
Lost on account of moving equipment	2.56	2.56
Lost on account of all other causes	1.51	3.02
Totals	35.20	39.27

Attention is invited to the fact that a greater proportion of days was lost in 1922 than in 1921. Also to the fact that delays due to causes within the control of the men on the job average about the same for the two years.

Those delays least subject to elimination by the contractor are the ones in which the widest variation shows between the two years. For example, the weather was more favorable in 1922 and contractors lost 4% less of their entire time from this cause than in 1921. On the other hand, the railroad situation in 1922 caused shortages of material which delayed the contractors nearly 9 times as much as in 1921, and caused them to lose 8.7% more of their total days. This quickly ate up all time saved on all other causes and left them behind as much as they otherwise might have been ahead.

Sundays and holidays and weather, as might be expected, make the largest draft on the contractor's available time. Breakdowns that cause a whole day's delay are rather noticeable by their absence. Apparently most up-to-date contractors have solved the problem of providing against delays of this sort by having on hand a stock of repair parts and a good live man to see that they are used. Moving and re-erecting of equipment seems to take up a larger amount of time than most of us would suppose.

"All other causes" for days lost include shortage of water, shut-downs to do grading work, shut-downs by the engineer or inspector to correct defective work, shortages of labor, strikes, etc. They are each one so small as not to justify separate classification.

The fractional days lost are classified under the same headings as the whole days with the exception of Sundays and holidays.

The figures are as follows:

	Percent 1921	Percent 1922
Lost on account of snow, rain, mud and frost	12.41	10.31
Lost on account of breakdowns of equipment	5.21	5.24
Lost on account of shortage of material	2.51	3.35
Lost on account of moving equipment	1.58	3.78
Lost on account of all other causes	4.55	6.70
Totals	26.26	29.38

These totals of 26.26 and 29.38 represent the percentage of days worked, on which some considerable delay occurred due to some cause or other. The average of actual days was 19.55 for 1921 and 18 for 1922. Subtracting these from days actually worked leaves 54.7 days for 1921 and 43.2 for 1922 as the total number of full days worked on the average by all the outfits in the State. On all the other days worked occurred some considerable delay that prevented them getting in a full day.

In an article appearing in the *Engineering News* in May, 1922, the following paragraph appeared. It is repeated here as expressing the sentiments of the writer on this matter:

> The almost universal habit of engineers to give honorable mention only to their livest contractors, of contractors to mention only their best day's run, and of equipment concerns to advertise only the job where their equipment was highly successful—have all created false impressions of the possibilities of construction progress. The record run that an outfit can make once in a season is a poor criterion by which to judge the efficiency of the outfit. Yet the public, and to too great an extent the profession itself, have these figures in mind in judging a contractor's progress. Alongside such records the mediocre performance of the steady producer seems unromantic and uninteresting, but the fable of the hare and the tortoise is as true today as it was when first told.

The low efficiency apparently indicated by many of the figures here given may lead to the thought that the contractors on the Iowa pavement were a small-calibre bunch. As evidence that this is not true some of the individual records are here appended. While there is no instance which set new marks for the contracting fraternity to shoot at, it is believed that they show that the organizations which have laid the Iowa pavements are well organized and alive to the necessities of their jobs.

One contractor between June 16 and July 30 inclusive, 45 calendar days, worked every day but the 7 Sundays and holidays, or 38 successive working days, laying in that time 20,658 ft. of 18-ft. pavement. This was an average of 543.5 ft. per day or 231½ cu. yd. of concrete.

Another contractor using two separate outfits worked both outfits every calendar day for 34 successive days from September 21 to October 24, 1921, laying in this time 29,347 lin. ft. of 20-ft. pavement 8 in. thick with integral curb and gutter. This was a total of 5.56 miles or an average of 432 lin. ft. per day. Reduced to cubic yards this made 218 cu. yd. per day per outfit. Not the least interesting feature of this run was that a weighted average of the haul shows every ton of this material hauled a trifle over five miles. The bulk of it was hauled over a hill road containing seven adverse 6% grades and many smaller ones. A large share of it was hauled up a single grade 9,000 ft. long, a part of which was 6% and which had a number of curves. Practically all the remainder was hauled up a grade a mile long, with several curves and some 6% grades. To complete the difficulties, a move was necessary with one of the outfits. By bringing in an extra mixer the remainder of the equipment was moved 15 miles across country and some pavement was laid on the same day.

One contractor using a 21-E paving mixer completed 11 miles of pavement in 1922 at the rate of 608 ft. for every day he turned a wheel and was at it 64% of the time.

Another contractor finished 16 miles of pavement in 1922 at the rate of 714.5 ft. for every day worked. He worked 67% of the time and yet made two long moves by rail during the season. This same contractor finished his last job by a continuous run of 20 calendar days at the rate of 920 ft. per day, laying 18,406 ft. of pavement in this time. The working day of this outfit was 10 hours long and this was seldom exceeded by more than a few minutes.

Runs of 1,000 to 1,200 ft. are numerous and 800 ft. was the common thing with many outfits.

There can be no debate about the expensiveness of lost time on construction work. The engineering force on the job is there and cannot be used for any other useful purpose as a rule, during the idle times. No increase in the engineering personnel would ordinarily be required if the lost time were eliminated.

Also, the contractor in order to continue being a contractor must make a living from his business, and it is impossible to hoodwink ourselves by trying to believe that the cost of his lost time is not charged to the work.

It would seem to be a matter of common interest among all concerned to join forces and do whatever is possible to eliminate waste time. All would profit in the end, the engineer by reputation for efficiency, the contractor by increased output and the public by reduced costs. Even the machinery manufacturers and material men have an interest, in the increased demand for their products.

These data and conclusions have the very common fault of being destructive rather than constructive. The writer has no solution to offer for the problem presented. In fact, it probably has no single solution. The betterment of the conditions noted will more likely come through the gradual whittling down of the delays at every point by the united efforts of all concerned.

The duty of the engineer in the matter seems clear. It will be his function to point the way, inasmuch as in his hands lie most of the facts and figures, or the opportunity to collect them. In this connection it is the desire of the writer to appeal to others more favorably situated than we are in Iowa, to keep similar records of lost time on highway work. Our program is small and our territory limited, while by extending this process to other states soon a valuable mass of data would be on hand.

Steel Road Forms

By J. D. Ackenheil
Highway Engineer
Heltzel Steel Form & Iron Co., Warren, Ohio

The use of steel forms for highway construction is rapidly becoming a universal practice and many of the highway departments of the country are now specifying steel forms for all tangents, and in some cases, flexible steel forms to take care of curvature less than 150-ft. radius.

The specifications of certain highway departments still permit the use of wooden forms and other specifications, and simply state that forms used must meet with the approval of the engineer. It is a notable fact that very few departments in their specifications state the requirements that road forms, steel or wooden, must meet. Notable exceptions are Pennsylvania, Illinois and New York departments—three of the few.

Many road defects have developed due to inferior forms, the chief ones being uneven surfaces and wavy conditions of the pavements.

Manufacturers and engineers have by cooperation improved the specifications applicable to steel forms to such an extent that the result is very apparent where roads have been built with the improved type of steel forms now on the market. The importance of steel forms in building the modern highways cannot be over-estimated.

The rapid development of modern road building machinery, particularly sub-grading, tamping and finishing machines, has been a large factor in necessitating the heavier type of steel forms.

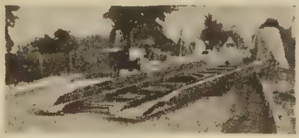
The highway engineer requires that the general contour of the pavement be as free from waves, ridges, depressions and other irregularities as can be accomplished by the most skilled workmen, aided by the most modern road building equipment. He requires that the crown of the pavement must be in conformity with the specified design. This can only be obtained by using the type of steel forms which meet the varying conditions existing on each individual project. The steel forms used must be sufficiently heavy to bear the weight of the grading and finishing machines, and be so firmly and rigidly staked that they will not bend, buckle, spring or slip under the weight and the terrific pounding as well as the vibration caused by the machines and the pressure of the concrete exerted against them by the tamping and compacting actions. The forms must remain true to line and grade after being so set, or irregularities of the pavement become a certainty.

It seems necessary that the highway engineer specify the type of forms.

It is also advisable to eliminate as many section joints as possible, thereby reducing the liability of ridges, depressions and roughness occurring where rails connect. This can be partly cared for by specifying steel forms in long sections of rigid design for the tangents and flexible steel forms, or 5-ft. rigid forms to take care of curvature less than 150-ft. radius. This, of course, requires the contractor to purchase both rigid and flexible steel forms. The contractor using wooden forms saves a small expense, but the general appearance of the curves suffers.

Wooden forms cost less in the first place but a great deal more in the last place. Steel forms if properly maintained, cleaned and oiled can be used for many years, whereas wooden forms are perhaps good for one fair sized job and are then scrapped. Steel forms can be set and stripped much more quickly than wooden forms. Steel forms will stand extraordinary abuse and rough handling. Wooden forms are soon battered out of shape, warped and cannot be bettered by the same means of maintenance applicable to steel forms. Wooden forms are difficult to set and strip, consuming considerably more time with additional cost of labor. Steel forms should not be figured by the contractor by cost per foot as they will outwear wooden forms for so many additional years, giving maximum good service.

Freeman Truck Turntable



A new motor truck turntable is made with a view to these requirements: carefully machined parts, housed, running in oil so that dirt cannot get in and oil cannot get out; load-carrying turning members so designed that irregularities in the road could NOT make it hard to turn; it must not block the road; must be self-balancing so that it will turn easily when on an incline; must be simple, without small parts to give trouble; rugged to stand the abuse of careless truck drivers, and light enough so one truck can drag it.

It is operated by one of the men working on the grade. He lifts one end so that the end toward the truck rests on the ground. When this end is down it remains down awaiting the truck. The truck runs up; when the center of gravity of the truck and load passes the first fulcrum the "runways" tip level. The driver sees it, he feels it and he hears it click. He puts on the brakes and comes to a stop in about 10 to 15 in. which puts his center of weight right over the center of the turntable. The turntable man pulls the lever down which lifts a foot. He walks around on the subgrade pushing on the lever to turn the table. He stops at the right point so that the truck is lined up to back right to the skip. The equipment is made by the Freeman Mfg. Co., Racine, Wis.

Ruggles Road Builder

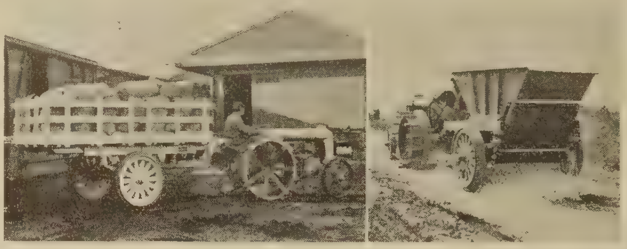
The Ruggles Road builder, shown in the accompanying illustration, was built to supply a truck adapted especially to the requirements of contractors.

The manufacturers call attention to these outstanding features: adequate motive power, truck balance, short wheel base, short turning radius, pneumatic tires, and special low gear ratio, providing unusually high tractive effect. It is particularly designed for use with a standard 21-E concrete mixer; is equipped with a dump body to carry two batches of material. The truck can be purchased with underbody hydraulic hoist and dump body or automatic gravity and dump body. For contractors who handle dry aggregate, the dump body is divided by a center swinging partition to handle 2, 4 or 5 bag batches. For mixed concrete, the center swinging partition is removed. For contractors handling gravel and earth, a 2-cu. yd. dump body is supplied, with double acting tail gate and spreading attachment. It is made by the Ruggles Motor Truck Co., Saginaw, Mich.

Steel Sash

There is an increasing interest in steel sash as offering facility and economy in construction and more durable work. The picture shows the use of such sash in a concrete block garage. The windows shown in the picture are 4 ft.-10⅜ in. wide and 6 ft.-10⅜ in. high, containing twenty 14-in. x 20-in. glass lights. The window of these dimensions is just 4½ blocks wide and 10 blocks high, using standard 8-in. x 8-in. x 16-in. block with ¼-in. mortar joints. In using such sash, the windows are first set around the building so as to be near the opening in which they are to be used. The wall is built up to the bottom of a window and then the window is set on and braced with a notched 2x4. The wires fastening the ventilators shut should not be removed until the windows are firmly installed. It is necessary to be sure to place the windows so that the ventilator will open in at the top and out at the bottom. This is done if it is remembered that steel sash are glazed on the inside. The next operation is to block up the windows so they are true and square and build up the walls at the side of the windows, grouting in as the wall goes up, filling in with grout around the head, sill and jamb bars. Wood or concrete lintels may be used, either precast or poured in place, if of concrete. In making lintels, small wood strips should be used on the inside to leave a rebate into which the flange of the top bar of the window may be inserted. A 2x4 cut diagonally in the center will provide two strips of the right size. The picture shows a window of the Detroit Steel Products Co., Detroit, Mich.

Miami Fordson Trailer



Miami Fordson Trailer Equipped with Stake Platform Body and (Right) with Dump Body.

The accompanying illustrations show the Miami Fordson trailer put out by the Miami Trailer Co., Troy, Ohio. This equipment, when equipped with the regular 2½-ton all-steel dump body, is designed for use in road building, excavation and hauling all other kinds of loose material. A stake platform body is also used as shown and is interchangeable on the chassis of the dump trailer. This latter unit is especially valuable to dealers in the building supply field.

The Miami Fordson trailer has been designed to meet the exacting conditions of reduced transportation costs on all classes and kinds of material. The stake platform body is made substantially and heavily reinforced, the heavy cross members in the body being supported by generous sized angle irons which are clamped to the frame of the regular Miami Fordson dump body trailer. The stake platform body is recommended for contractors, who have purchased the trailer with the dump body, and wish to haul other materials not suited for dump equipment.

The winding and release levers are operated from the tractor driver's seat, making it unnecessary to stop the tractor trailer unit for either dumping or winding and it can be backed into any position. It is a continuous one-man operation.

Another Triumph for Heltzel "Armour Plate" Steel Road Forms, Heltzel Steel Form & Iron Co., Warren, Ohio, an illustrated circular describing the use of the Heltzel armor plate steel road forms in the construction of the Lincoln Highway Ideal Section.

Link-Belt Portable Loaders, catalog No. 550, Link-Belt Co., Nicetown, Philadelphia, Pa,. describes the company's line of portable equipment; 8½ x 11 in., 32 pages and cover, handsomely printed in two colors. The descriptions and illustrations include the large one-man power swivelling loader, the portable belt conveyor, the standard "A" machine for anthracite coal and the "CS" loader for handling sand and gravel.

Dayton-Dowd Centrifugal Pump. Bulletin No. 249. By Dayton-Dowd Co., Quincy, Ill. This new bulletin is 7½ x 10½ in. and supercedes Bulletin 244. It contains 32 pages of interesting material about the centrifugal pump made by that company, illustrated by views of actual installations under various conditions. Considerable hydraulic data and engineering information are included together with diagrams and

Keeping Up Concrete Pipe Quality

(Continued from page 94)

Water Supply

Several water supply systems have been awarded: at Greeley, Colo., East Orange, N. J., Norfolk, Va., and Tulsa, Okla. In the latter city, the job is one of the largest on record requiring 52 miles of 54-and 60-in. concrete pipe. The actual value of the pipe alone is $3,000,000.

The centrifugal method of producing concrete pipe has been introduced this year in this country by the Lock Joint Pipe Co., Ampere, N. J. (See Concrete, November 1922, p. 162), and the Centrifugal Concrete Products Company of America at Dallas, Tex. The latter concern secured the rights to manufacture pipe under the Hume patents which have been used extensively in South Africa, Australia, France and England. The Lock Joint Pipe Co. is producing this class of pipe on especially designed machines under its own patents and the pipe is fitted with expansion joints owned by that company.

Irrigation

Two associations of irrigation pipe manufacturers are in existence in California: the Southern California Associated Concrete Pipe Manufacturers, at Los Angeles, and the California Associated Concrete Pipe Manufacturers at Fresno. Both associations are doing good work in improving the quality of pipe produced by the various manufacturers and also in promoting the sale of good pipe in that territory.

The manufacturers of irrigation pipe have practically no competition except among themselves. Unfortunately there are a large number of concerns operating on a small scale, paying little attention to proper methods of manufacture. The result is that many failures occur due to inferior quality. The pipe produced, however, by the leading firms in that section of the country is of good quality and vast quantities are sold.

Culverts

Progress has been made by the Joint Concrete Culvert Pipe Committee which has under preparation Standard Specifications for railroad and highway culvert pipe. This committee consists of two representatives each from the American Concrete Institute, American Association of State Highway Officials, American Railway Engineering Association, American Society for Testing Materials, American Society of Civil Engineers, American Concrete Pipe Association, Bureau of Public Roads, U. S. Department of Agriculture. Dean Anson Marston of Iowa State College is chairman.

Concrete culvert pipe is being extensively used in all parts of the country for railroad and highway construction. Because of its great strength and permanence its use has become very popular. Every effort is being made by the association to encourage state and county as well as railroad officials to test culvert pipe in order to insure a high standard of quality. It is recognized that concrete culvert pipe has the high regard of these officials and we are making every attempt to have this favorable opinion continue.

Drainage

Excellent work has been done by the Minnesota Concrete Drain Tile Manufacturers Association under the direction of Roy H. Allison. The apparent dark outlook this industry had in Minnesota as a result of the failures of concrete drain tile, disclosed in an investigation carried on by the government in 1920, has changed under cooperative effort. The Minnesota manufacturers have overcome much of the prejudice against concrete tile in that state. Up to September, 1922, approximately 105,000 tons of tile had been sold for drainage systems in Minnesota, 100,000 tons of which went for concrete and 5,000 to our competitors.

In Iowa and Wisconsin the drainage business has shown a considerable improvement over 1921. The manufacturers in Wisconsin faced considerable antagonism on the part of certain state officials. It is believed, however, that the industry faces a bright future in that state, since the quality of tile produced has been considerably improved during the past two years. The Wisconsin Concrete Pipe and Tile Association has been cooperating with the Drainage Department of the University of Wisconsin and specimens of tile are sent in monthly from various plants for tests.

A report has been prepared by John T. Stewart, consulting engineer, St. Paul, Minn., on the "Performance of Concrete Drain Tile in Peat Soils and in Soils Containing a High Percentage of Decayed Vegetable Matter." This report will be of great value to the drain tile manufacturers in Wisconsin, Minnesota and other sections of the country, in overcoming prejudice against our product as a result of investigations that have been carried on by several college officials.

Sewers

Reinforced concrete pipe (24 to 108 in.) has been extensively used for the last fifteen years for building sewers. Its use has become standard practice in practically all sections of the country, and this is largely the result of the production of good quality pipe by a number of responsible manufacturers over a considerable period of years. The excellent performance of this pipe has gradually convinced skeptical engineers and municipal officials that it is equal or superior to any other type of sewer building material.

Sewer contractors have and are providing themselves with equipment suitable for handling large units, and in 1922 two jobs were awarded: one in which the largest diameter pipe was 96 in. (weight 3,090 lbs. per ft.), and the other 108 in. (weight 3,860 lbs. per ft). The fact that such units can be inspected easily before and after laying and trenches can be immediately backfilled, makes their use popular with both engineers and contractors.

The small unreinforced pipe (4 to 24 in.) has made rapid strides, particularly in the Middle West, South and East, during the past year. In previous years greater rate of progress was made in establishing this industry on the Pacific Coast, particularly in Southern California and Oregon. This class of pipe has also been extensively sold in Michigan over a period of ten years. Over fifty municipalities in New York, New Jersey, Pennsylvania and several of the New England states, have opened their specifications to sewer pipe of the smaller sizes during 1922. In the South this class of pipe has been introduced in Tennessee and Louisiana and a large job was awarded in New Orleans and one at Cape Girardeau, Mo.

April 11, 1922, a meeting of an Advisory Committee consisting of representatives from the cement, concrete pipe, clay brick and pipe interests was held in Los Angeles, Calif. This meeting was called by the Bureau of Standards to discuss means of carrying on an investigation on the performance of concrete and clay pipe in the Los Angeles Sewerage System. At this meeting it was developed that the Bureau of Standards had been requested to make this investigation by and at the expense of the clay interests. At the meeting, however, representatives of the clay interests invited the concrete pipe and cement interests to share the expense which was estimated at $7,500. In view of the fact that the city of Los Angeles had not made a request for such an investigation, both the cement and concrete pipe interests declined this invitation. An advisory committee, however, was appointed, consisting of one representative for concrete pipe, (E. F. Bent, Los Angeles, Calif.), one each from the city of Los Angeles and the clay interest and two from the Bureau of Standards. To date, nothing has been disclosed in this investigation that would indicate that concrete is unsafe for such construction. In fact, concrete pipe that was examined which has been used for a period of years was found in excellent condition.

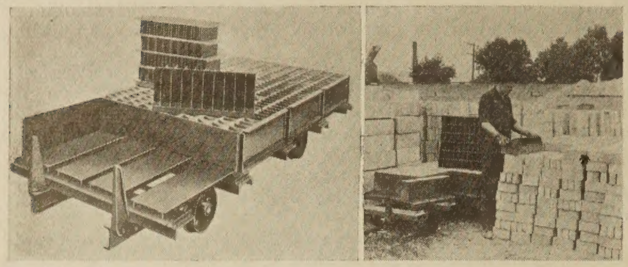
Two meetings of Committee C-4, Sewer Pipe, of the American Society for Testing Materials, were held during the year, one at New York and one at Atlantic City. The clay interests are attempting to introduce acid tests in their own specifications. Since such conditions rarely exist in sewerage systems, concrete representatives as well as a number of consulting engineers are not in favor of such a procedure. This is clearly a commercial move on the part of our competitors. Efforts are also being made by the clay representatives to introduce "single strength" or "standard pipe" in their own specifications (in diameters 15 to 36 in.). This would mean a reduction in the required supporting strength at 8.2% in case of the 15-in. and 18.2% in case of the 36-in. This request, from all indications, will not be granted by the committee.

A report by a committee of the American Society of Sanitary Engineering, a plumbers' organization, was issued in 1921 and has been published extensively in the plumbers' trade journals. While this report when carefully read is not extremely harmful to our industry, the photographs showing concrete pipe in various stages of disintegration have had a bad effect on a number of municipal officials who are not in a position to appreciate the class of concrete pipe that had been originally used and failed. The committee did not go into the history of the pipe but merely reported results of experience with concrete whose history was not known. The president of the above organization has indicated that the concrete pipe manufacturers will be given a chance to present their side of the case and the matter will be taken care of before the next convention of the Society, which will be held in September, 1923.

At the fifth annual meeting of the National Slag Association, held in Cleveland, Feb. 16, C. L. McKenzie of the Duquesne Slag Products Co., Pittsburgh, Pa., was elected president; C. E. Ireland of the Birmingham Slag Co., Birmingham, Ala., vice president; and H. J. Love, Leader building, Cleveland, secretary-treasurer.

Eighty-five per cent of the tonnage of commercialized Blast Furnace Slag is represented by the membership of the association.

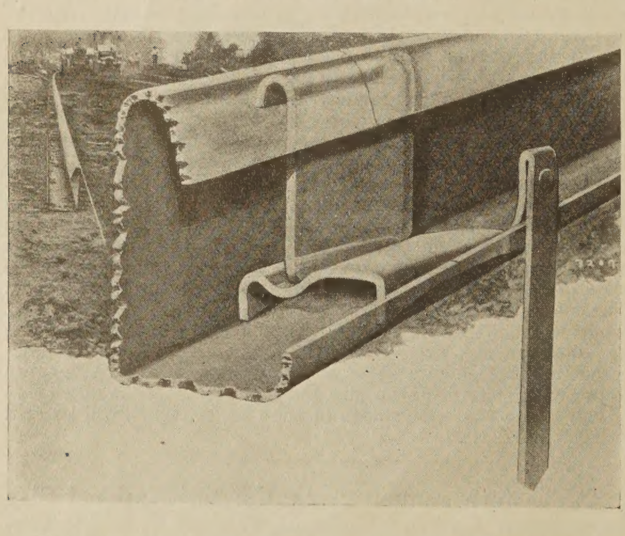
Zagelmeyer Brick Molds



Gang molds for the manufacture of cast concrete brick are being put on the market by the Zagelmeyer Cast Stone Block Machinery Co., Bay City, Mich. The equipment is shown in the accompanying illustration. Each mold has a capacity of 400 brick, so arranged that they are removed from the molds and stacked in units of 10 at a time. The gang mold, so set up that the brick are made on end, is mounted on a roller bearing truck; the mold is filled direct from the mixer spout, just as Zagelmeyer block are made. The car is then run into a curing tunnel, heated by steam, where the concrete hardens. The only handling of the brick is in their removal from the molds in which they are cast. This operation is shown in one of the accompanying pictures.

Several years ago, the Zagelmeyer company began an effort to develop a practical method of manufacturing concrete brick, and two years ago the present molds were perfected. Frank Zagelmeyer, president of the Zagelmeyer company, put them in use on a commercial scale in three of the Zagelmeyer block plants, in which the company says it has been demonstrated that concrete brick can be made to sell in direct competition with common clay brick. Under ordinary curing conditions one mold producing 400 brick is used every 24 hours. Thus 25 cars of gang molds will give a plant output of 10,000 brick per day.

Carr Road Form



The illustration shows the Carr road form, placed on the market by the Lakewood Engineering Co., Cleveland, O. It is made of $\frac{3}{16}$-in. metal, the locking arrangement consisting of two simple wedges to give a rigid connection. The forms are made in 12-ft. lengths, to minimize joints. A feature of the new form is the top surface, which is so rounded that material cannot lodge there to get under the wheels of the finishing machine or subgrader and cause them to ride too high. Flat stakes are used, having a penetration of 18 in. The base is 5 in. wide. These forms were used on several jobs last season.

Atlas Mixer With Reserve Hopper

A new Atlas batch mixer has a reserve hopper which is filled with materials of a desired proportion while the previous batch is being mixed in the mixing drum and discharged, thus resulting in the opportunity to speed up the operation and the output. The capacity of the machine in loose material is 3 cu. ft. It is run by a $1\frac{3}{4}$ h.p. gasoline engine; weight of outfit about 1300 lbs; height of loading hopper about 40 in. The mixer is mounted on trucks. It is made by the Atlas Engineering Co., Milwaukee.

Organizations

American Concrete Institute: Secretary, Harvey Whipple, 1807 East Grand Boulevard, Detroit. Convention February 25 to 28, incl., 1924; place undecided.

American Concrete Pipe Association, M. W. Loving, Secretary, 111 West Washington St., Chicago.

American Engineering Standards Comm., Dr. P. G. Agnew, Secretary, 29 W. Thirty-ninth Street, New York City.

Asso. General Contractors of America, G. W. Buchholz, Secretary, 1038 Munsey Bldg., Washington, D. C.

Associated Metal Lath Manufacturers, 123 W. Madison St., Chicago; Wharton Clay, Commissioner.

Building Officials Conference; Rudolph P. Miller, President, Fred W. Lumis, City Hall, Springfield, Mass., Secretary. Annual meeting April 24-27, inclusive, in Toledo, Ohio.

Iowa Cement Stave Silo Association; H. E. Kilmer, Secretary, Oskaloosa, Ia.

Mid-West Concrete Products Assn., D. R. Donlen, Secretary-Treasurer, 4340 Marcy St., Omaha, Neb.

The National Concrete Stave Silo Association; W. G. Kaiser, Secretary, 111 West Washington St., Chicago.

National Crushed Stone Assn.; A. P. Sandles, Secretary, 405 Hartman Bldg., Columbus, Ohio.

National Housing Assn.; Lawrence Veiller, Secretary and Director, 105 East 22nd St., N. Y. C.

The National Lime Association; Mather Bldg., Washington, D. C.

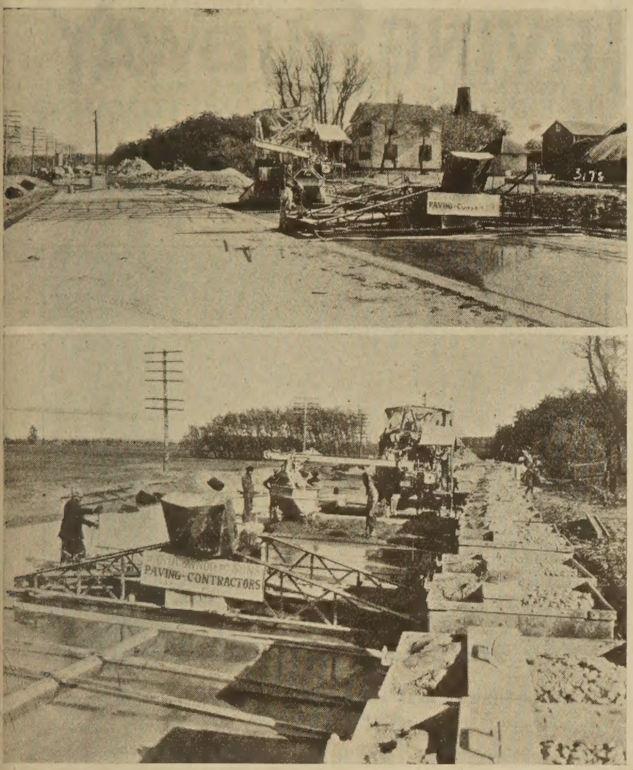
National Sand and Gravel Producers' Association; T. R. Borrows, Acting Secretary, 903 Munsey Bldg., Washington, D. C.

Portland Cement Association; William M. Kinney, General Manager, 111 West Washington Street, Chicago.

Engineers License Law—Compiled by the American Association of Engineers, Chicago, Ill.; 6 in. by 9 in., 136 pp., bound in blue paper; $0.50.

This is a compilation of the acts in those states in which all-inclusive license laws for professional engineers have been enacted. Sixteen states are represented.

Finishing Lincoln Highway Double Slab



The pictures show the construction of the Ideal Section of the Lincoln Highway where a 20-ft. finishing machine was used on a 40-ft. pavement, built in two strips.

One of the questions which arose was how the Lakewood finishing machine was to be used. The contractor, J. C. O'Connor & Sons, Fort Wayne, Ind., solved the problem successfully by putting on a special set of wheels when the machine was used on the second half. These wheels consisted of two double flanged ones, which ran on the outside form, and two without flanges, which rode on the concrete of the first slab.

Results were entirely satisfactory and in view of the number of roads which are now being planned for construction in half widths this method has attracted considerable attention and undoubtedly will be followed on many jobs this coming season. Pictures are from the Lincoln Highway Association.

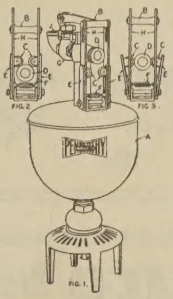
The Association states that in some way the impression has gained currency that the "Ideal Section" cost $100,000.00 a mile. This is not the case. The cost of the reinforced pavement, which by the public is generally considered as the "road", was but $64,897.20 per mile, this for 40 ft. of concrete, 10 in. thick and reinforced with 80 lbs. of steel per 100 sq. ft. Two bridges were included in the Ideal Section link and these two structures cost a total of $23,174.26. These expenditures are by no means extravagant. Additional funds were spent by the Association in the development of the design, and in carrying out many added features recommended by the technical committee. The cost of the landscape work, which involved much preliminary planning and would not be necessary to duplicate if 100 miles instead of but one were beautified, was $4,800 per mile, while the cost of illuminating the section for night travel was but $4,051 per mile.

A Short Cut in Handling Concrete

In work on the New York State's Barge Canal, it was found very difficult to dislodge mixed concrete from Koppel cars, which were being used to transport it from a large mixing plant. The concrete settled, due in some measure to the jarring and natural setting, during the period it was in transit. It had become so firm that it required considerable work with shovels and severe pounding of the steel sides of the cars to dislodge it. Various expedients were tried to remove the difficulty, but none worked so well as a simple loose platform of boards placed in the bottom of each car. The purpose of this platform was to allow water to collect under the mass of concrete instead of on its surface. It was found in using this platform that no further difficulty was experienced in dumping the concrete, nor was there any necessity for further damage to the cars.

Automatic Cellar Drainer

A wet cellar is a bugaboo. The Penberthy Injector Co., Detroit, says it can be prevented by building in a little well or sump to which any seepage water in the basement will drain and installing an automatic cellar drainer, which is operated by city water pressure, stops and starts without suggestion, except as seepage water raises a pump valve on the apparatus and starts the pump.

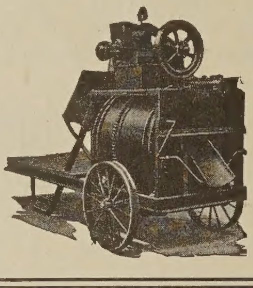


Allen Sand Tank, Bulletin No. 23—By the Allen Cone Co., engineers, El Paso, Texas. Size 6 in. by 9 in., 40 pp.; paper cover, illustrated. The Allen sand tank is described as a machine for making high grade concrete sand and other building sand. It can also be used by itself, or in combination with other machines, made by the Allen Cone Co. for making special sand or sands which have to meet definite specifications. It is claimed that the Allen sand tank is unique in that it is the first machine designed and built solely for the use of sand washing plants which included specifications by which the product may be varied at the will of the operator.

Besides describing and illustrating the Allen sand tank and accessories, an interesting chapter is devoted to sand testing.

E. A. H. Daw, engineer and manager of the Expanded Steel & Concrete Products Co., Sydney, New South Wales, in writing of the progress of concrete construction in New South Wales, says that it is making headway despite high cost of cement and of stone, sometimes inferior quality of aggregate, and against brickwork of particularly good quality. He mentions that buildings of concrete have not been of any great magnitude up to the present time, but that there is now in progress a structure thirteen stories high. This is the first building in Sydney of this height wholly constructed with concrete framework.

The Archer Mixer—built in a variety of sizes—is described in detail in a well illustrated book which we'll gladly send to any mixer user. Ask for a copy—learn the many money-saving features of this mixing equipment.



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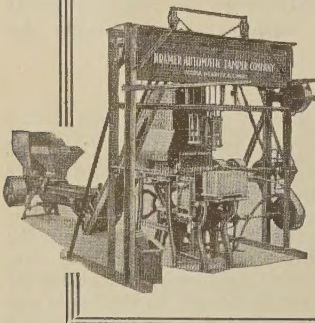
KRAMER Brick and Block Machines



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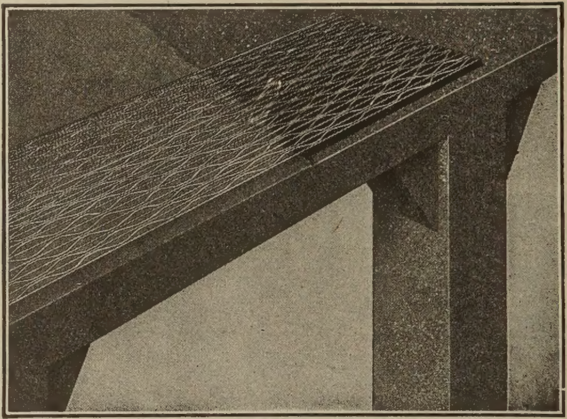
For Concrete Armoring



Irving Subway used as Concrete Armoring on Concrete Loading Platform

Where the Service is Hardest

You can't expect concrete to stand up indefinitely under the hammer-like blows of unloading barrels, boxes, etc., and the wear-and-tear of heavy traffic. Unless it is armored, you'll have broken surface spots and unsightly patches. **Irving Subway,** bedded flush in the topping, takes shocks and wear on its steel bars—protects the concrete surface—keeps it smooth and non-slipping indefinitely. The picture shows how easily it is laid. Let us send Catalog 5A 27.

IRVING IRON WORKS CO.
LONG ISLAND CITY, N.Y., U.S.A.

Manufacturers of

IRVING SAFSTEP
TRADE MARK
(PATENTED) REG. U.S. PAT. OFF.
ABSOLUTELY NON-SLIPPING ALWAYS